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***CARBON CHAINS*: AN ELEMENTAL ETHNOGRAPHY**

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ABSTRACT

Carbon Chains: An Elemental Ethnography

Felicia Allegra Peck

Climate change is commonly understood to be an intractable political problem. It is also widely assumed that the solution to the problem is a rather straightforward reconfiguration of humanity's interactions with "carbon." If global warming is so clearly fixable, and so much work has long been underway to accomplish this fix (carbon offsets, international negotiations, localized climate initiatives, etc.), then why does the quagmire continue? This dissertation explores the stagnant "progress" of climate politics by using "carbon" as the locus of its mixed-methodological approach. The dissertation creates a new nomenclature, presented as a glossary at the beginning of the text, to represent the diverging meanings and underlying assumptions conveyed by different "carbon" invocations. This terminology facilitates the dissertation's material-semiotic analysis of climate politics, which combines discourse analysis, multi-sited ethnography, and object tracking of "carbon." The analysis finds that the dominant, carbon-based discourse of climate politics reinforces modernist assumptions that inspire a perpetual faith in the ability of humans to solve the climate problem through carbon management, regardless of evidence to the contrary. This discourse, ironically, enables a widespread estrangement of carbon the signifier from carbon the signified in global climate governance. This lack of fidelity between material "carbon" and representations thereof is also encouraged by the ubiquity and invisibility of elemental carbon; when apprehended largely with a

reductive emphasis on quantifiability, and put in combination with market incentives, "carbon" is a fungible and easily co-opted entity. Therefore, despite "carbon's" appeal as a policy mechanism (thanks again to its perceived quantifiability), it is a misguided foundation for climate policy. The likelihood of failure according to the carbonized terms by which the problem has been defined is the "elephant in the room" of climate activism. The liberal capitalist global order that has summoned anthropogenic climate change may find itself challenged by the monster it has created. The dominant, carbon-centric discourse through which the problem is (not) addressed, amounts to an attempt of that order to control its monster without significantly changing itself.

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Reader's Guide to Notation

This dissertation begins with a short glossary that gives an overview of how "carbon" has been formulated herein. This explanation of the politics attached to the word carbon relies on differentiating between the multiplicity of the word's meanings by assigning them separate monikers. Consider this analogy from chemistry: some elements come in more than one form, or allotrope. For example, depending on how the atoms are arranged, elemental carbon can take the form of both diamond and graphite. Both allotropes are carbon, but they are obviously different as well. In the guide to carbon notation that follows, other forms of carbon – we could think of these as post-material[1] allotropes – are given as well.

The formulations given in the glossary derive from a system of classification that blends taxonomy and dictionarial definition with shorthand that resembles the form of chemical notation – a both convenient and appropriate linkage with the subject matter's historical bonds to the science of chemistry. In chemical taxonomy, chemists classify compounds (especially elements) by many criteria relating to form and function, e.g. according to how structure relates to chemical reactions (to give a gross simplification, but the details are not important here). Similarly, the glossary classifies different forms of the word carbon by differentiating between, e.g. when it refers to greenhouse gases (GHGs) writ large, i.e. from both "natural" and

[1] The "post" prefix was chosen to covey a logic parallel with post-modernism. This "post-materialism" should be distinguished from the notion of post-materialism that describes advanced industrial societies – typically brought up in the context of environmentalism to convey the (tangential to this dissertation, and debatable) proposition that people in these societies embrace environmental values as a reflection of their privileged position.

"unnatural" sources ($\text{Carbon}_{\text{GHG}}$), and when it is used to signify anthropogenic GHGs in particular ($\text{Carbon}_{\text{anthropos}}$).

The purpose of this nomenclature is to distinguish as well as draw connections between the many meanings, connotations and political implications tied to the matter (both in its material and representative sense) of carbon. The notation is, I believe, rather succinct and relatively intuitive, and therefore should aid in the reader's understanding of the situation (rather than detract from it). While this notation is not used in this preface or in the dissertation's title or sub-titles within, it is used in the remainder of the work.

In addition, following the defined terms, a number of variants, off-shoots and derivations are given. These come, most commonly, in the form "carbon + other word." In these cases, carbon is to be thought of as modified and put into context through combination, rather than classified through the prior, specified notation. Put differently, these variants of carbon are treated as "single" terms in their own right, not as multiple terms put aside one another (in which case, the given instance of the word carbon would be subject to classification through the above notation).

Glossary

Carbon$_{\text{word}}$ **C$_{\text{word}}$**	the representative power of the spoken or written word spelled c-a-r-b-o-n in English
"Carbon"	the spoken or written word spelled c-a-r-b-o-n in English, as used uncritically in common parlance or general discourse in the context of climate change; this usage implies at least (and usually more than) one of the following: C$_{\text{element,}}$ C$_{\text{dioxide,}}$ C$_{\text{GHG,}}$ C$_{\text{anthropos.}}$ That is, "carbon" has these four subtypes, though it may refer to more than one of these subtypes simultaneously. ("Low carbon" is its negative equivalent.)
Carbon$_{\text{element}}$ **C$_{\text{element}}$**	an abundant chemical element fundamental to life on earth
Carbon$_{\text{dioxide}}$ **C$_{\text{dioxide}}$**	shorthand for carbon dioxide (in the context of climate change)
Carbon$_{\text{GHG}}$ **C$_{\text{GHG}}$**	shorthand for emitted or potentially (not) emitted greenhouse gases, whether or not they are from "natural" sources

Carbon$_{\mathbf{anthropos}}$	shorthand for all "anthropogenically" emitted or
C$_{\mathbf{anthropos}}$	potentially (not) emitted greenhouse gases

CARBON

C

a two-part dynamic in which certain underlying assumptions about how the climate changing world works are maintained through outward statements regarding "carbon."

These assumptions are:

1) reductive (especially quantifiable) strategies pave the path to a solution
2) agency (and hence responsibility) can be attributed through rational calculation
3) energy flows can be reordered on a massive scale without a social reorganization of comparable magnitude
4) solutions follow logically and easily from knowledge, which humans are progressively mastering

Carbon

The word used away from the climate change context, in reference to carbon fiber, carbon-copies, etc.

“Single” terms exempt from notation described above

Carbon capture and storage

Carbon credit

Carbon dioxide (often abbreviated CO2 or CO_2)

Carbon emissions

Carbon footprint

Carbon free

Carbon intensive

Carbon leakage

Carbon management

Carbon market

Carbon neutral

Carbon offset

Carbon price

Carbon sequestration

Carbon tax

Carbon trading

Decarbonization

New carbon economy

Climate Conundrum

On May 10, 2013, it was reported that average global atmospheric CO_2 readings for a single day passed 400 parts per million for the first time in millions of years. The New York Times[2] asked several scientists to describe the significance of the event:

It symbolizes that so far we have failed miserably in tackling this problem.
-Pieter P. Tans, director of a CO_2 monitoring program at the National Oceanic and Atmospheric Administration

It means we are quickly losing the possibility of keeping the climate below what people thought were possibly tolerable thresholds.
-Ralph Keeling, director of CO_2 monitoring program at the Scripps Institution of Oceanography

If you start turning the Titanic long before you hit the iceberg, you can go clear without even spilling a drink of a passenger on deck… If you wait until you're really close, spilling a lot of drinks is the best you can hope for.
-Richard B. Alley, climate scientist at Pennsylvania State University

The Problem

According to most any layperson, politician, or expert who believes climate change is a serious problem that demands action, progress against it has been far too slow. There are countless examples of this sentiment, but space requires that only a few be given as illustrations here. Academic theorists write, "The news on climate

[2]Justin Gillis, "Heat-Trapping Gas Passes Milestone, Raising Fears," *New York Times*, May 10 2013. Accessed at http://www.nytimes.com/2013/05/11/science/earth/carbon-dioxide-level-passes-long-feared-milestone.html?ref=science&_r=1&

change is, of course, uniformly bad and getting worse." [3] A Time magazine piece states, "political inertia in the face of unprecedented threat is the most fundamental challenge to tackling climate change."[4] A scientist, "the grandfather of global warming," believes that "when people start feeling the real effects of global warming, they will be ready to do something [i.e. pay a carbon tax]."[5] Former US Vice President and unsuccessful presidential candidate Al Gore asks, "why is it that humanity is failing to confront this unprecedented mortal threat?"[6]

There is also a widespread consensus that there is much that can be done; a plethora of proposals and tactics have been devised, and even put into effect, albeit to an extent insufficient to match the magnitude of the climate problem. Proposals for carbon taxes, energy efficiency programs, consumption reduction efforts, carbon sequestration, buying local, increasing alternative transportation, cap and trade, etc. have been proposed, analyzed, modeled, discussed, and implemented at different scales. The problem does not seem to be that no one knows what can be done, but rather that something else – the consensus based international system, the US Congress, poorly informed voters, consumerism, energy sector lobbyists, etc. – tends to get in the way of doing what should be done.

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[3] Joel Wainwright and Geoff Mann, "Climate Leviathan," *Antipode* 45, no. 1 (2012): 3.
[4] Kharunya Paramaguru, "The Battle over Global Warming Is All in Your Head," *Time*, May 2013. Accessed at http://science.time.com/2013/08/19/in-denial-about-the-climate-the-psychological-battle-over-global-warming/
[5] Wallace Broeker, in: Steven A. Edwards, "An Interview with "the Father of Global Warming"," AAAS, http://science.time.com/2013/08/19/in-denial-about-the-climate-the-psychological-battle-over-global-warming/.
[6] Al Gore, "Our Choice: A Plan to Solve the Climate Crisis," (2009): 300.

As the preceding paragraph notes, there seem to be many pathways for taking action against a warming climate. At root, however, these paths are overwhelmingly tied to a rather singular notion of solving the problem: getting “carbon” under control (albeit with different tactics to advance this singular strategy). On the one hand, this focus on “carbon” is hardly surprising, as it should be evident to even the casual observer that “carbon” has arisen as the symbolic terminology of this depressing politics. On the other hand, “carbon” tends to be spoken of as something whose place in the politics of climate change is so obvious that it needs little or no explanation. Without “carbon” serving as this central focal point, stories like the following would seem strange:

> David Greene (host of US national radio program):
> [H]ow much would it cost to deal with a global problem [climate change] that seems intractable? Well, surprisingly, some experts say, the problem isn’t actually that hard to solve…
>
> David Kestenbaum (radio reporter): Henry Jacoby, an economist at MIT’s business school, says really there is just one thing you need to do.
>
> Jacoby: If you let the economists write the legislation it could be really simple.
>
> Kestenbaum: If you were to write it, how short could it be?
>
> Jacoby: Well, if I were to write it, a page.
>
> Kestenbaum: What Jacoby would write on that page, is a carbon tax. Basically, he says you tax the fossil fuels in proportion to the amount of carbon they release. That would make coal, oil and natural gas more expensive. And then – actually – that’s all he has to do… And this is why economists love a carbon tax. One change to the tax code and the entire economy shifts to reduce carbon emissions. No complicated regulations, no rules for what kind of gas mileage cars would have to have or what specific fraction of electricity has to come from wind or solar or renewables.

> [Further explanation is given that the plan also assumes that the revenue from the carbon tax would be used in lieu of reduced revenue from income taxes, which the plan would cut in order to stimulate the economy, making up for the depressing effect of higher energy prices that the carbon tax would cause.]
>
> Kestenbaum: I called around and talked to a bunch of economists about this, and they said the idea was basically sound. If you give the money back by cutting taxes you can probably offset a lot of the pain. President Obama has indicated he would support a market-based solution to climate change, but a carbon tax would, of course, require an act of Congress, and right now that seems unlikely.[7]

Under the current state of affairs, this vignette is rather standard fare. It sends the message that climate change is easily solvable through "carbon," but also that we should not expect the problem to actually be solved.

By making the carbon cycle visible in how humans procure and utilize energy, "carbon's" entry into the political lexicon seems to promote a more integrated view of social, economic and environmental relations. The convergence around "carbon" suggests an aspiration toward agreement, perhaps a faith in the idea that there is a "correct" scientific way to quantify and calculate an optimal energy arrangement. According to this idolatry, "carbon" serves as the basic unit that allows balanced coordination between technologies, economic markets, human actions, and the global climate.[8]

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[7] David Kestenbaum, "Economists Have a One-Page Solution to Climate Change," NPR, http://www.npr.org/templates/transcript/transcript.php?storyId=196355493. June 28, 2013

[8] An example of this effort to use carbon as the basis of conversion is evident in the US government's calculation of the "Social Cost of Carbon," which is to be taken into consideration when the government designs new regulations. It is designed to predict the cost of present technologies and regulations, such as appliance energy standards, so that their cost to future generations can be accounted for. IWGSCC, "Technical Update of the Social Cost of Carbon for Regulatory Impact Analysis," (United States Government: Interagency Working Group on Social Cost of Carbon, 2013). Accessed at

Illustration 1) Electric car parked in Berkeley, California, with vanity license plate, “HALT CO2”

Yet, it is obvious that our agreement about “carbon’s” importance has not eliminated conflict. Rather, in its discursive ascendency, “carbon” has become a potent marker of political division: an individual’s carbon footprint may, for example, be cast as a source of pride or shame, depending on their political views. The driver of an electric car with a “HALT CO2” vanity license plate [image 1, page 10] is obviously proud of their environmental action. Those who modify their trucks to “roll coal,” i.e. make after-market alterations in order to make a political statement by

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http://www.whitehouse.gov/sites/default/files/omb/inforeg/social_cost_of_carbon_for_ria_2013_update.pdf demonstrating their personal capacity to pollute and flout emissions regulations, are saying something quite different about "carbon"[9] [image 2, page 11]. On online forums that discuss "rolling coal," enthusiasts also tout some of their favorite bumper stickers, such as "Prius Repellant," and "I Have a Huge Carbon Footprint."[10]

Image 2) A Diesel Truck "rolling coal."[11]

Others have critiqued the environmentalist emphasis on "carbon" as ineffective as well. In their influential "The Death of Environmentalism," Nordhaus and Schellenberger describe the US environmental movement's resort to "carbon" as

[9] Hiroko Tabuchi, "'Rolling Coal' in Diesel Trucks, to Rebel and Provoke," *The New York Times*, September 4 2016. http://www.nytimes.com/2016/09/05/business/energy-environment/rolling-coal-in-diesel-trucks-to-rebel-and-provoke.html
[10] TDICLUB, "Prius Repellant," http://forums.tdiclub.com/showthread.php?t=354589.
[11] Salvatore Arnone, *Cc by 3.0* (https://commons.wikimedia.org/w/index.php?curid=46760635).

one illustration of its limited strategic vision:

> The environmental movement's failure to craft inspiring and powerful proposals to deal with global warming is directly related to the movement's reductive logic about the supposedly root causes (e.g. too much carbon in the atmosphere) of any given environmental problem.[12]

The authors also criticize the movement's focus on "carbon" because "savvy neocon strategists" have "turned the regulation of carbon emissions into the *bête noire* of the conservative movement.[13] Their critique, however, is not of "carbon" based policies *per se*; rather, they reference unsuccessful "carbon" based policy proposals as examples of American environmentalism's general ineffectiveness and uninventive tactics.[14] Similarly, Lohmann is critical of carbon markets in particular, stating that "the strategic question" raised by their intensifying contradictions is "how to build the most effective possible movements to address the climate threat that is now posed by carbon markets themselves."[15] That is, Lohmann takes issue with "carbon's" commodification, but does not offer a wholesale rejection of "carbon" as an environmentalist icon.

The certainty and simplicity with which most climate activists are prone to regard the climate problem as an obvious one of "carbon" only serves to make the

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[12] Ted Nordhaus and Michael Schellenberger, "The Death of Environmentalism: Global Warming Politics in a Post-Environmental World," (2004).14-15. http://www.thebreakthrough.org/PDF/Death_of_Environmentalism.pdf.
[13] Ibid. 23.
[14] What they endorse instead is a push for investment in the development of low-carbon energy technology (this message is what their Breakthrough Institute has been actively promoting since the publication of the original article over a decade ago). As will be argued at various points in this dissertation, however, there is reason to be skeptical that this plan really amounts to an "alternative" to CARBON, or would be a successful climate strategy.
[15] Lohmann, L. (2011). "The endless algebra of climate markets." Capitalism Nature Socialism **22**(4): 110.

unsatisfactory progress on global warming even more depressing. This dynamic fosters a political atmosphere in which perpetual disappointment becomes the norm. Take the introductory paragraph of this article about public understandings of the causes and implications of climate change:

> Tackling climate change has been considered for years a problem that policy makers were supposed to solve through an international agreement that imposed limits on CO_2 emissions. This task has proven to be, throughout the years, one of the most difficult challenges that the international community has ever been called to face because of the number of ethical, political and economic issues it raises. It is now clear that the success of the Montreal Protocol for tackling ozone depletion may not be replicated any time soon.[16]

This tension—between the assumed simplicity and ease of "carbon" and the frustrating ineffectiveness of climate activism—is explored in depth in this dissertation.

This tension situates the politics of climate with post-modernity. CARBON is a descendent of the modernist paradigm that views knowledge as a tool for mastery of the world; the seeming failure of CARBON to translate knowledge to mastery with regard to the climate problem places it in post-modernity.[17] Climate knowledge tells us that $C_{anthropos}$ is rather out-of-control and making a post-modern mess; CARBON is a universalizing discourse, and resistance to universalization is a condition of post-modernity. Examined in this light, the climate movement should be asking to what

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[16] Francesca Pongiglione, "The Key Role of Causal Explanation in the Climate Change Issue," *THEORIA. Revista de Teoría, Historia y Fundamentos de la Ciencia* 27, no. 2 (2012).2.

[17] Post-modernity is a broad and contested term. Here, it refers to the struggle to reconcile the continuation of universalizing modernist ideals with the realization of the immense consequences of modernist projects, e.g. the environmental and social devastation wrought by enormous dam projects or nuclear meltdowns.

extent CARBON is serving their aims—and whether it is possible that it is working against them. This dissertation, in its engagement with the centrality of C_{word} to climate change politics, is an invitation to such a discussion.

Research Question

Why is climate change politics so intractable and divisive, "a failure" so far? A wide variety of answers to this question has been suggested. Blame has been laid with the ineptitude of environmental activists, the antics of skeptics, the selfishness of individuals, the public's ignorance of science, the inability of humanity to work together in its self-interest, and more.[18] Combined together, however, these still do not present an adequate explanation of why climate change inspires as much acrimony and as little action as it does. Taken together, the various explanations still do not add up to much; they do more to say *that* something is always in the way, not *why* something is always in the way.

As previously noted, attempts to combat climate change overwhelmingly translate into efforts to control "carbon," such as fostering low carbon lifestyles, creating carbon credits for cap and trade programs, and planning for industrial decarbonization. Accordingly, in order to understand why climate politics seems to go nowhere, this dissertation makes "carbon" a central object of study. This dissertation tells the story of the development and political ascension of "carbon," and

[18] I go into considerable depth describing each of these explanatory frameworks in chapter three, "Carbon Compulsion."

in so doing demonstrates that the discourse of CARBON is at the heart of the intractability of climate change politics. In this light, climate activists should question their assumption that CARBON is the key to making things right.

Failure and Intractability in Climate Politics

The laments over the intractability of climate politics point to different markers of failure. Among the most commonly mentioned are public opinion polls that find inadequate belief in, understanding of, or prioritization of climate change in comparison to other "competing" issues[19]; difficulty in creating, extending, or ratifying international treaties that would rein in greenhouse gas emissions[20]; criticisms of international treaties or national policies on greenhouse gases that do pass, but adopt such low targets that their climatic influence is likely to amount to a small drop in a big bucket[21]; and most directly, the steadily upward trajectory of atmospheric concentrations of carbon dioxide.[22]

Optimists may argue that markers of hope and progress can be found. For example, there are plenty of instances of decentralized initiatives, such as municipal or regional climate action plans. Examples of voluntary behavioral changes, reflected

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[19] Anthony Leiserowitz, "International Public Opinion, Perception, and Understanding of Global Climate Change," *Human development report* 2008 (2007).
[20] William Nordhaus, "Climate Clubs: Overcoming Free-Riding in International Climate Policy," *The American Economic Review* 105, no. 4 (2015).
[21] Katharina Rietig, "Reinforcement of Multilevel Governance Dynamics: Creating Momentum for Increasing Ambitions in International Climate Negotiations," *International Environmental Agreements: Politics, Law and Economics* 14, no. 4 (2014).
[22] Nicola Jones, "Troubling Milestone for Co2," *Nature Geoscience* 6, no. 8 (2013).

by eco-conscious bumper-stickers, t-shirts, and cloth diapers (seen overwhelmingly on the babes of white, liberal, environmentally-concerned parents) in the West, are also not hard to find. Yet, these initiatives are far from ubiquitous, and those who drive a Prius are likely to be charging their iPad and hopping on an airplane as well.

Others root their optimism in a faith that the climate can be improved through ecological modernization or measures such as carbon taxes that aim to green capitalism. In practice, however, advances in efficiency from "ecological" modernization are often accompanied by increases in consumption or human population that offset the ecological benefits of increased efficiency,[23] and advocates of ecological modernization often disavow strategies that aim to reduce consumption.[24] Even when ecological modernization advocates critique the "carbon" preoccupation of some environmentalists (as described earlier), they nonetheless are devotees of the assumptions of CARBON discourse. For example, the "Ecomodernist Manifesto" states, "transitioning to a world powered by zero-carbon energy sources will require energy technologies that are power dense and capable of scaling to many tens of terawatts to power a growing human economy."[25] This statement relies on (zero) "carbon" to point to a solution, which is to be achieved through knowledge (i.e. research into more energy efficient technology), without disrupting forces that

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[23] Lorna A Greening, David L Greene, and Carmen Difiglio, "Energy Efficiency and Consumption—the Rebound Effect—a Survey," *Energy policy* 28, no. 6 (2000).
[24] For example, John Asafu-Adjaye et al., "An Ecomodernist Manifesto," *The Breakthrough Institute* (2015). 10, 21.
[25] Asafu-Adjaye, J., et al. (2015). "An ecomodernist manifesto." The Breakthrough Institute: http://www.ecomodernism.org/. 22-23.

organize social life (increased energy production to enable economic growth).

In other words, CARBON does more to reinforce than undercut the capitalist organization of the current world order. Most significantly, if any one thing can be blamed for our current episode of "anthropogenic" climate change, it is the reign of capitalism.[26] For this reason, the current moment has been characterized as the *Capitalocene*[27] (in juxtaposition with the Anthropocene). Under this order, fossil fuels, overwhelmingly the source of the $C_{anthropos}$ that is of concern, have become ''locked in''[28] to industrialized societies' ways of life. There are indications that this lock-in is globalizing, making it unlikely that industrializing economies will leapfrog "carbon" intense periods of development.[29]

Given that "it is the globalization of *carbon burning*, in both physical and social terms, and the vast growth in global economic activity linked to "carbon" that has led humanity and the Earth to its current precarious position,"[30] concern about "carbon" makes sense. CARBON, however, sends the message that the capitalist order needs only minor reform, which can be achieved by utilizing the count-ability and value-ability of "carbon" to account for the problem of environmental externalization via the operation of capitalism itself. Yet, the extent of capitalism's

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[26] Eric R Wolf and Thomas Hylland Eriksen, *Europe and the People without History* (Univ of California Press, 2010).
[27] Jason W Moore, "The Capitalocene," *Part I: On the Nature & Origins of Our Ecological Crisis* (2014).
[28] Gregory C Unruh, "Understanding Carbon Lock-In," *Energy policy* 28, no. 12 (2000).
[29] Gregory C Unruh and Javier Carrillo-Hermosilla, "Globalizing Carbon Lock-In," *Energy Policy* 34, no. 10 (2006).1185-1197.
[30] Ronnie Lipschutz and Felicia Allegra Peck, "Climate Change, Globalization, and Carbonization," in *The Routledge International Handbook of Globalization Studies*, ed. Bryan S Turner and Robert J Holton (Routledge, 2015). 194-195.

imbrication with fossil fuels indicates that only a transformation of this order would be sufficient to meet the problem of climate change as it has been defined (e.g. the goal of keeping warming below 1.5 or 2 degrees Celsius). In this context, Chakrabarty asks, "would the world, scrambling to avoid the tipping point of the climate, make the economy itself tip over and cause untold human misery?"[31] In short, as summed up in a review of current anthropological research on climate change, "capitalist systems" are responsible for "making emissions reductions so politically and economically intractable today."[32]

As a discourse that is to enable *global* action on *global* climate change, CARBON is understood through the global frame. In this vein, CARBON is also resonant with Harvey's association of post-modernity with late capitalism's seeming compression of time and space.[33] The round and homogenizing undertones of globalization, however, belies the patchwork, point-to-point, [34] networks[35] and friction[36] through which globalization operates. That is, the globalized, i.e. universalized, tone of CARBON discourse coexists with a great deal of unevenness in the practices that follow.

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[31] Dipesh Chakrabarty, "Climate and Capital: On Conjoined Histories," *Critical Inquiry* 41, no. 1 (2014). 8.
[32] Jessica Barnes et al., "Contribution of Anthropology to the Study of Climate Change," *Nature Climate Change* 3, no. 6 (2013). 543.
[33] David Harvey, "Time-Space Compression and the Postmodern Condition," *Modernity: Critical Concepts* 4 (1999).
[34] James Ferguson, *Global Shadows: Africa in the Neoliberal World Order* (Duke University Press, 2006).
[35] Manuel Castells, *The Rise of the Network Society: The Information Age: Economy, Society, and Culture*, vol. 1 (John Wiley & Sons, 2011).
[36] Anna Lowenhaupt Tsing, *Friction: An Ethnography of Global Connection* (Princeton University Press, 2011).

To illustrate via analogy, Ferguson's view of globalization from Africa is one wherein "capital flows and markets are at once lightning fast and patchy and incomplete; where the globally networked enclave sits right beside the ungovernable humanitarian disaster zone." He continues, contending that the globe-hopping character of globalization means that 'so-called global forms of economy, politics, and regulation have no inherent advantage in dealing with environmental issues,'"[37] as the results of such efforts will be similarly uneven. As this dissertation will illustrate, Ferguson's assertion bears out with regard to CARBON as the basis of a global strategy to fix climate change.

Beneath the pervasiveness of C_{word} in the politics of climate change lies the uncomfortable question of the control-ability of "carbon." That is, can "carbon" be controlled sufficiently to solve climate change, and, if not, does its uncooperativeness doom climate activism, at least in its CARBON formulation, to failure? Given that controlling "carbon" requires significant control over the workings of humanity, the question of control-ability extends the theoretical purview of this dissertation to the issue of agency. The logic that attaches "carbon" to global climate change illustrates the centrality of conceptions of agency to this area of politics: human agency to avert the climate crisis derives from prescient knowledge of the high CO_2 concentrations already determined to exist in the future. In other words, "the" future of catastrophic climate change *necessitates* action in the present in order to be averted. If the present functions out of a determined necessity, then we are left with two, contradictory

[37] Ferguson. 49.

understandings of human agency in the present. On the one hand, we have the agency to decide to change the future by altering how humanity interacts with “carbon.” On the other hand, an alternate reading of the discourse suggests that we seem to have no choice but to alter how humanity interacts with “carbon,” as failure to make the “correct” choice will lead to climate catastrophe—and calamity for humans along with it. This oddity reveals that the irresolvable tension between determinant and contingent modes of thought is foundational to climate politics itself.

“Carbon's” new political role carries the tension between contingency and determinism wherever it goes. This tension is embedded within the narrative of climate change. In it, the portrayal of climate change as inevitable (if humans do not act differently) coexists with the persistent message that we *can* save ourselves. The first missive of doom, combined with the second of hope, creates discordance. If climate change is "inevitable," then human agency would seem to be irrelevant. Yet, the "inevitability" of climate change is contingent upon human action, as indicated by the anthropogenic formulation of climate change: therefore, climate change is not inevitable in the purest sense of the word. If humanity can either succeed or fail at addressing climate change, and if success would amount to a radical shift in the socio-natural order, then we are left with a confounding agency problem: Either way, hasn’t climate change forced its agency upon humanity? Put differently, can climate change really be ignored, even if it is ignored?

The situation can also be communicated through synecdoche. In “traditional” societies, outside of modernity, extreme weather events (e.g. climate fluctuations that lead to food crises) have often been seen as reason to question the legitimacy of rulers. If the position of leaders is seen as the result of divine provision, and the forces of weather and climate are understood as similarly following from divine forces such as weather Gods, then climatic changes can be read as a message that the current form of the social order has lost its divine sanction. For example, the Hittite Empire (much of which is now Turkey), fell around 1200BC, after weather-related famine and water-shortages: "for the Hittites, the land belonged to the weather god, who merely entrusted it to the custody of the royal clan; the king's supreme religious duty was to enter into dialogue with the god."[38] This example suggests a question: does climate change delegitimize and threaten to overthrow the capitalist rule of the current world order?[39]

Overview of the Argument

Climate activists speak of strategies to control "carbon," by which they mean something more or less straightforward: anthropogenic greenhouse gas emissions. There is an overwhelming acceptance of the assumption that attention to "carbon" should guide climate governance. For instance, Al Gore writes,

> In a market economy like ours, every one of the solutions to the climate crisis will be more effective and much easier to implement if we place a price on CO2… Once we have a price on carbon, the negative externality that was

[38] Wolfgang Behringer, *A Cultural History of Climate* (Cambridge: Polity, 2007 (reprinted 2010)). 56.

[39] Another possibility for consideration in future research: capitalism is strengthened—and inequality along with it—as new opportunities for profit emerge from the new configuration of risk and scarcity that climate change produces.

> invisible and not tracked by the market will become visible and will be included in the decisions of the market participants.[40]

This simplistic, deductive reasoning has a logical appeal; however, as this dissertation will demonstrate, C_{GHG} does not comply with this vision of the world. This research proceeds by rejecting the notion that a CARBON based approach to climate change is obviously what is needed. Instead, it focuses explicitly on the messages that underlie various invocations of “carbon.” The dissertation demonstrates that CARBON offers a deeper understanding of the intractable and divisive character of the politics of climate change.

The argument comes in three parts. First, underneath these impulses to control “carbon” lie assumptions and aspirations regarding how the world does, should and should have worked. By and large, when the word “carbon” is uttered with reference to climate change, the following assumptions are summoned, and thereby reinforced and reenacted:

1) reductive (especially quantifiable) strategies pave the path to a solution
2) agency (and hence responsibility) can be attributed through rational calculation
3) energy flows can be reordered on a massive scale without a social reorganization of comparable magnitude
4) solutions follow logically and easily from knowledge, which humans are progressively mastering

[40] Gore. 327.

CARBON refers to a dynamic in which these underlying assumptions are maintained through outward statements regarding “carbon.” In short, when the word is said, the assumptions are understood.

The second dimension of the argument follows from the first: the assumptions that accompany and are reinforced by “carbon” help to perpetuate, as well as explain, the intractable character of climate politics. CARBON is fundamental to the depoliticization of climate change. A growing literature references, and critiques as ineffective, the “depoliticized”[41] status quo of the dominant, a/political approach (sometimes referred to as “antipolitics”) to climate change as a problem to be addressed through technical, bureaucratic, expert, elite, and market-based “carbon management.” CARBON—the dynamic between the aforementioned assumptions and the word that describes and enables calculations of more straight-forward and (theoretically) material greenhouse gases—is a fundamental “element” of this techno-managerial approach. Depoliticization through CARBON has another side as well: climate change “activism” tends to be reduced to expressions of support for technocratic solutions. Because of the depoliticizing tendencies of “carbon,” its mention, ironically, has the potential to undermine the political-ecological climate project for which it is so often invoked. Most importantly, depoliticization is ineffective because “carbon” is not nearly as controllable as CARBON makes it seem.

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[41] This literature is explained in more depth in the introduction to chapter two.

The third part of the argument regards the implications of the second: it is difficult to find viable solutions to the climate problem that comport with the CARBONized construction of climate politics. Minor modifications to the current order run the risk of doing more to perpetuate it than to change it; small adjustments create the impression that the current system is able to handle the problem, rather than itself being the main source of the problem. A "real" response to climate change necessitates systemic changes, i.e. change of such a great magnitude that the result would be a new global order. The questions climate change suggests (but CARBON discourse obscures), therefore, are to what extent this social order is worth keeping, as well as to what extent and for how long climate change will allow that social order to remain intact.

When climate activists follow the path of quantification, reductionism and mastery, they are working within the modernist mode that has materialized anthropogenic climate change; it is unlikely that this same approach can be employed to bring about the opposite outcome. Indeed, this approach appears to be doing more to reinforce the status quo of the present, climate-harming global order, than of remediating climate change.

To sum up, the dissertation argues that "carbon," as the politicized signifier of climate change, challenges the underpinnings and highlights the philosophical tensions of the presiding global order; in so doing, it creates the appearance that it is the solution to the problem that, ironically, it tends not to resolve but to intensify. CARBON discourse facilitates a large degree of dancing around the elephant in the room: the possibility that climate change is not solvable according to its "carbon"ized construction.

Theoretical Considerations

> *Is a warming planet 'fierce enough to rouse' Leviathan? Or will Leviathan 'beg for mercy'?*[42]

This research demonstrates that discussions of "carbon" implicitly contain assumptions about "agency" (see especially chapter three). Different invocations of "carbon" can assume different, often conflicting, agential assumptions. The emphasis on *anthropogenic* climate change means that humans are at times presented as material beings lacking agency, and other times as beings whose agency puts them in a position to transcend a determined, material world. The notion of anthropogenic climate change as a matter of physics, in accordance with universal laws that determine how the atmosphere functions (giving climate change an aura of material inevitability) comes into conflict with the notion of humans as beings whose agency is the source of contingency *to alter the inputs into* the physical system. That is, (human) agency is deemed to be, in a sense, immaterial (and therefore in some sense transcendent), whereas the climate system is oppositely portrayed as non-agential, and simply subject to the combination of inputs and universal laws that govern it.

Commentators seem incapable of mentioning current atmospheric concentrations of CO_2 without invoking *projected,* ecologically devastating levels on

[42] Wainwright and Mann. 1.

the horizon. These projections typically take the form of a range of juxtaposed scenarios implying better and worse futures in indirect relation to quantities of $C_{anthropos}$. In short, these scenarios *determine* climate change to be *contingent* on "carbon." The directive to take action "now" hinges on knowledge that is based in the "carbon" determined model of the future; either the projected, dire scenario of the future that exists in the present comes not to exist in the "real" future, thanks to the future's existence in the present, or, conversely, the unfortunate future will indeed come to exist if it is not sufficiently foreseen and acted upon in the present.

How "agency" is understood is significant for how climate politics transpires. The typical conception of agency is anthropocentric: it is only human agency that is given political consideration. If agency is constructed without (human) consciousness and intentionality being regarded as a prerequisite (this alternative orientation is fundamental to Science and Technology Studies[43]) then agency, most basically, is regarded as the ability of some-"thing" to influence another "thing." Following this construction, agency can be understood as just as much a property of the climate (and "carbon" and CARBON) as humanity.

The imperative to follow the dictates of CARBON brings the familiar notion of agential human into a position to confront the perhaps uncomfortable proposition of material, climatic agency. This "flat" ontology makes it easier to incorporate the

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[43] For example, this is expressed in such key ideas in STS as Actor Network Theory (ANT) and material agency. For explanations of the former, see: Bruno Latour, *Reassembling the Social: An Introduction to Actor-Network-Theory* (Oxford University Press, 2005). For the latter, see: Jane Bennett, *Vibrant Matter*, A Political Ecology of Things (Duke University Press, 2009).

diverse temporal and spatial scales at which climate change operates. $C_{element}$ is basically immortal, yet invisible; individual human life spans are much shorter than the "deep time"[44] that is fundamental to understanding climate; $C_{dioxide}$ in the atmosphere can continue its warming effect long after the human whose action "released" it has perished. The lifespan of CO_2 molecules in the atmosphere is measured in decades and centuries. The diverse physical and temporal scales of the different entities' agencies also reveal the ontological open-endedness that undercuts efforts to make firm causal attributions regarding responsibility for climate change. This issue is explored throughout the dissertation, though particularly through the discussion of Gillespie's proposition that a provisional resolution of the relationship of God/man/nature founds modernity (discussed in detail in chapter four).

The conviction that "carbon" is the route to saving the world, put face-to-face with the depressing failures of climate politics, suggests an additional underlying formulation of the agency issue in regard to climate: "can we save ourselves, or are we doomed?"[45] It is not a question that anyone can respond to with a definitive, empirical answer—and the probabilistic statistics of climate change and "carbon" reduction calculators cannot give a definitive answer either. Rather, that very question is embedded within the narrative of climate change. Calculations implying that we know "what is to be done" suggest perhaps too great a level of certainty, acting as

[44] Stephen Jay Gould, *Time's Arrow, Time's Cycle: Myth and Metaphor in the Discovery of Geological Time*, vol. 2 (Harvard University Press, 1987).
[45] The discourse of catastrophism is relevant and entwined here, as it too has been accused of fostering inaction. See, for example: Sasha Lilley et al., *Catastrophism: The Apocalyptic Politics of Collapse and Rebirth* (PM Press, 2012).

uncomfortable attempts to obscure an uncomfortable question. The discourse of CARBON encourages people to act as if the answer to that question is known rather than unknowable.

Methods

The universe is made of stories, not of atoms.[46]

This research is, above all, organized by the research question: *what explains the intractability of climate politics?* To answer this question, the method borrows from a variety of techniques that others have employed, in particular: discourse analysis; object-tracking; hermeneutic interpretation; interviewing; and participant observation. This "mixed-method" is tailored to fit the political and technical complexity and historical breadth that the research question involves. This approach is in line with a trend in cultural anthropology, in which "anthropologists have been moving away from studies of individual communities to analyses of the ways in which people, objects and ideas are interrelated across space and time in a globalized world."[47] One aim of this dissertation is to serve as a demonstration of how this approach can be useful for answering questions befitting of political science. If one method could be said to dominate, it is discourse analysis, with the others operating in its service. Therefore, this section briefly outlines the mixed-methods and "data" that

[46] Muriel Rukeyser, "The Speed of Darkness," in *The Collected Poems of Muriel Rukeyser* (https://www.poetryfoundation.org/poems-and-poets/poems/detail/56287: 1978).
[47] Barnes et al. 542.

the dissertation draws upon, and ends with a more detailed description of the type of discourse analysis the dissertation conducts.

No research can be conducted without starting from some ontological assumptions and without an epistemological orientation. There is no "aperspectival,"[48] "view from nowhere." Ontologically, this dissertation is rooted in the constructivist assumption that linguistic and other "representations" of the world "out there" are an important part of the "real" world, not apart from it. The epistemology that follows, therefore, is attentive to constructions of the world, e.g. climate models, as part of "reality," not mere representations of or outside it. "Carbon" flows through social, political and material life as both a discursive construct and a physical entity. In short, this research studies climate politics in a fashion that takes material and social forces both seriously.

This orientation is similar to the concept of socio-technical systems, which is referenced at several points in the dissertation. The socio-technical systems approach contends that the fundamental building blocks of modern society, both human and technical, cannot be disaggregated in practice, despite cognitive tendencies to think of them as separate in an abstract sense. Descriptions of socio-technical systems point out the linkages and pathways through which "social" and "technical" systems are

[48] Lorraine Daston, "Objectivity and the Escape from Perspective," *Social Studies of Science* 22, no. 4 (1992).

enmeshed, e.g. incorporating communities, governments, markets, supply chains and electricity grids into the same, synthetic description.[49]

Overall, the approach taken here is much more qualitative than quantitative, and has an ethnographic character. The object tracking strategy comes from "multi-sited ethnography," outlined by Marcus.[50] With object tracking, the researcher "follows the thing," to different sites. The "thing" that this research follows is "carbon." This method is well-suited to approaching matters of connections that take place at or across large scales, e.g. globalization and climate change. In multi-sited ethnography, the researcher focuses on chains, paths and juxtapositions between locations, with the explanation of how the sites are connected forming the basis of the argument.[51] As adapted here, the connections between different invocations of "carbon" in climate politics are analyzed and connections are drawn in the service of answering the research question of why climate politics has been so intractable (rather than their connections forming the basis of the argument itself.)

The breadth and variety of "data" drawn upon in this research—temporally, spatially and disciplinarily—is appropriately matched to the scope of the problem that the research question addresses. The centrality of "carbon," in climate politics, and the multiple meanings that C_{word} conveys, invite hermeneutic interpretations of the situation. The vast time frame that "climate" evokes, means that several geological

[49] Clark A Miller, Jennifer Richter, and Jason O'Leary, "Socio-Energy Systems Design: A Policy Framework for Energy Transitions," *Energy Research & Social Science* 6 (2015).29-40.
[50] George E. Marcus, "Ethnography in/of the World System: The Emergence of Multi-Sited Ethnography," *Annual Review of Anthropology* 24 (1995).
[51] Ibid. 105-106.

concepts are relevant. The elemental roots of "carbon," and the essential role of atmospheric chemistry in defining the climate problem, makes chemistry relevant as well. Of course, the science of climate modeling is of particular significance. A period of participant observation in a climate modeling lab for several months (which led to ongoing conversations and interactions with a climate modeling community for years to follow), therefore consumes a significant portion of the research. The ubiquity of "carbon" means that research was ongoing, with relevant materials and moments often finding the researcher. Trips to the grocery store, family gatherings, and a number of events (e.g. workshops and conferences) provided surprise "data" for the project. Less surprising sources are included as well, e.g. the reports of the Intergovernmental Panel on Climate Change, and coverage of climate change in various media outlets.

The "chains" of the dissertation's title, play on many attachments to "carbon": the chemical bonds of $C_{element}$ chemistry; the commodity chains of a fossil-fuel (and thus "carbon" based) economy; the restrictions (metaphorical chains) that CARBON places on climate politics, etc. Such breadth, of course, goes against the trend in academia of ever narrower research topics and more restrained methodologies. The significance of this research question, however, is self-evident, and a (relatively) full answer can only be given by a methodological approach that can follow the breadth and depth of the situation wherever it leads. Had the same question been constrained with more methodological limitations, the answer would doubtless be of limited import as well. Big questions are worth asking, and big answers are worth giving.

A discursive approach, directed through the tracking of "carbon," makes the magnitude of this dissertation's research question manageable. The flexibility of discourse analysis makes it well adapted to big questions and multidimensional situations. This is especially the case given the particular dynamics of how science and politics intersect: although the abstract category of "fact" is taken to be a proper guide for good governing, *particular* facts are often challenged and are frequent fodder for episodes of political contention. The social/natural order depends on *the idea* of governance via facts, which makes particular facts into targets for the unfolding of politics. (This arrangement, and how it came to be established, is outlined in chapter one.) As Litfin notes:

> The political impact of scientific knowledge is determined far more by its incorporation into larger discursive practices than by either its validity or the degree to which it is accepted by scientists. Science, then, is not likely to save us from environmental ruin, persistent political action informed by carefully chosen discursive strategies might.[52]

Because facts are what it is agreed *should* undergird our governance, challenging or establishing something's facticity becomes an obvious if ironic gathering point for political contestation. This dynamic underpins CARBON discourse: climate activists invoke "carbon" to convey the reality of climate change, and denialists dismiss this "carbon" based vision of reality.

The discourse analysis here builds upon the discursive practices approach that Litfin developed for analyzing ozone negotiations[53] (a topic of obvious relevance to

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[52] Karen Litfin, *Ozone Discourses: Science and Politics in Global Environmental Cooperation* (Columbia University Press, 1994). 198.
[53] Ibid.

this investigation of climate and "carbon"). Litfin defines discourse as "sets of linguistic practices and rhetorical strategies embedded in a network of social relations."[54] As opposed to "agent-centered and physicalist coneptions of power,"[55] Litfin's discursive practices approach draws on Foucault's conception of disciplinary power moving through linguistic structures of knowledge. This move de-centers the (human) subject, allowing room to demonstrate how (human) subjects influence, are influenced by, and exert influence through discourse.

While noting the significance of power-knowledge, through discourse, in science politics, Litfin carefully maintains a human-centered conception of agency. For instance, she states that the usefulness of the discursive practices approach is according to "the extent that the power and perceived interests of social actors are rooted in how they frame and interpret information."[56] Litfin uses discourse to explain outcomes of the international ozone regime, as opposed to analyzing the regime developments as primarily a product of the actions of actors such as states, bureaucracies, or individuals. The analysis in this dissertation goes further by joining discourse analysis with an epistemology that accounts for material agency. In other words, the analysis here regards discourse as not belonging to or being conducted by humans alone: humans are not the only agents that need to be accounted for in climate politics. Here, the discursive analysis of "carbon" finds that "carbon" is not

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[54] Ibid. 3.
[55] Ibid. 7.
[56] Ibid. 12.

merely a discursive object, but an active, material-semiotic subject.[57] That is, "carbon" has agency: it both enables and resists the dictates of CARBON discourse; it is a messenger, warning of climate change; and it conjures the "reality" that it also destabilizes.

Significantly, discourses operate in a messy field in which they challenge one another, i.e. as counter-discourses. The shifting dynamics between discourses can be tracked as a way of describing political developments—e.g. Litfin describes the development of the ozone regime as a story in which a pro-regulatory counter-discourse overtakes the previously dominant anti-regulatory discourse. Notably, especially in the case that a discourse is in a dominant position, "discourses define the menu of possible policy options,"[58] as they exercise "the power to delineate the boundaries of thought."[59] Marginal, counter-discourses resist dominant discourses as alternative power-knowledges.

CARBON is a strong, dominant discourse. The response of NGOs to "carbon" provides one illustration of how discourse enables what framings and possibilities can be imagined. Although the norm among European environmental groups in the 1990s was "widespread criticism" of carbon markets, a new norm of "cautious acceptance" emerged in the 2000s as institutional support for large carbon markets made them

[57] In Actor Network Theory, "carbon" might be conceived as an "actant," i.e. as a thing that acts through its re/formative role in an assemblage of socio-natural order. The ANT approach is being avoided here, despite the shared ontological orientation with regard to material agency, as this analysis goes beyond description of an assemblage (a task to which ANT is well-suited) but to answer an explicitly political question. See: Bruno Latour, "On the Difficulty of Being an Ant: An Interlude in the Form of a Dialog," in *Reassembling the Social: An Introduction to Actor-Network Theory*, ed. Bruno Latour (2005).
[58] Litfin. 189.
[59] Litfin. 38.

more and more real and the United Nations Clean Development Mechanism (UN CDM) and the European Union Emissions Trading System (EU ETS) were formally established.[60] The situation now is that mainstream environmental NGOs are overwhelmingly working within the discourse of CARBON, regardless of the extent to which they support or criticize carbon markets. The World Wildlife Fund (WWF) originated a "gold standard" system for accrediting carbon credits, which dozens of environmental groups help support. The gold standard can add value to a credit, as projects that attain it have been subjected to stricter environmental standards than what is required of CDM projects.[61] The result is to reaffirm the logic of CARBON—which is also the logic that supports the markets that the "gold standard" implicitly also critiques.

A counter-discourse to CARBON is potentially emerging from the radical "climate justice" association of environmental groups, most notably Carbon Trade Watch. Climate Justice groups (also known as the Durban coalition) have been critiquing the commodification and financialization of nature and distributionally unequal consequences thereof for marginalized human communities, with increasing intensity over the last decade. In response to the 2015 United Nations Climate Change Conference (Paris COP), they published a treatise impugning carbon markets. Buried within the report are the seeds of a challenge to CARBON itself:

> we must stop talking about carbon emissions once and for all. Let's not talk about the 2800 GtC [gigatons of carbon] that exists underground or the 565

[60] Anders Blok, "Clash of the Eco-Sciences: Carbon Marketization, Environmental Ngos and Performativity as Politics," *Economy and Society* 40, no. 3 (2011). 462.
[61] Ibid. 464.

> GtC that “we” supposedly “can” still emit. Who decides this budget? What is it to be used for, and by whom? If such questions cannot be democratically debated, it would be better simply to discard this dangerous “carbon budget” terminology. It would be better for the IPCC to talk about oil barrel equivalents rather than tons of CO2, and at the same time to create two more scenarios, one assuming that 70% of underground fossil fuels will remain untapped and another assuming that 100% will remain untapped.[62]

More to the point:

> Low carbon metrics reduces reality to a single narrative and makes invisible conflicts of interests, power plays, ideologies and provides contradictions of reality, and further subjects individuals and collectives to structural violence and injustice.[63] [sic]

Despite the above examples, the organizations that comprise the Durban group, especially Carbon Trade Watch, have been critiquing market based environmentalism for some time, and their critique of “carbon” remains largely grounded within this anti-commodification narrative: so far, the climate justice focus is not “carbon” but an “[attempt] to turn the market frame *as such* into a site of political contestation.”[64] Overall, their approach mostly functions within CARBON discourse. For example, the counter-proposal to the CDM proffered by the influential, India-based NGO, Center for Science and Environment (CSE), is to distribute emissions entitlements on a per capita basis instead.[65] That approach would continue the focus on measurement and the myopic tendencies of CARBON to marginalize environmental concerns that are not articulated in and on its terms.

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[62] Climate Justice, "Paths Beyond Paris: Movements, Action and Soidarity toward Climate Justice," (http://www.carbontradewatch.org/downloads/publications/PathsBeyondParis-EN.pdf2015). 13.
[63] Ibid. 19.
[64] Blok. 464.
[65] Ibid. 467-468.

Significance

This dissertation contributes to a range of discussions, not limited to academia, making it relevant to a variety of audiences with a range of purposes in mind. Foremost, it is resonant with discussions of: global environmental politics; problem definition in the policy process; social movement strategy; mixed-methodology; environmental political theory; and the topic of climate change politics.

Those who identify as climate activists will find the dissertation's central examination of the failures of climate politics to be significant for discussions of movement strategy. An implicit though perhaps inherently unanswerable question that would emerge in such a conversation is whether climate politics would be better off had "carbon" not taken such a central political position. In other words, readers may wonder if this dissertation suggests that activists should consider different rhetoric for attacking climate change, and what an alternative might entail.[66] This is a conversation worth having, and it is a conversation that would take another dissertation-sized effort to properly engage. Given that obscure treatises from the ivory tower do not typically have a large or direct influence on the political situations they examine, such a conversation would probably be more worthwhile if it were to take place outside the confines of a single research project, involving a broader range

[66] To a degree, this conversation is already happening with the move toward educating scientists in "climate communication," and "science communication," through workshops and networks sponsored by professional societies like the American Geophysical Union and organizations like Climate Central. Their tack, however, has been largely rooted in psychology, e.g. giving advice such as not scaring the audience so much that they become hopeless and apathetic.

of contributors. Accordingly, this dissertation suggests and notes the seeds of potential alternative framings of climate and environmental politics only in passing.

In much of the scholarship by political scientists that relates to "carbon," "carbon's" position in the analysis is taken for granted, e.g. acting as the proper measure of the success of different environmental governance projects or environmental progress as a whole.[67] This dissertation suggests that this reliance on "carbon" as the proper metric of 'how green something is' should be questioned. For much the same reason, scholars of social movements or policy formation should take the dissertation's criticisms of CARBON discourse under consideration, especially in examinations of framing and problem-definition.

By extension, this research also suggests an area for further exploration, the trend in environmental politics that has made climate change an increasing and overwhelming part of "the environmental agenda." Scholarly analyses of environmental politics overwhelmingly assume that this shift in focus is a simple reflection of the state of scientific knowledge about the state of the environment: i.e. merely a reflection of the urgency and gravity of climate change itself.[68] This research suggests the possibility that the reductionism of CARBON discourse reaches so far as to discursively marginalize other environmental issues. For instance, the argument

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[67] For example: Barry G. Rabe, *Statehouse and Greenhouse: The Emerging Politics of American Climate Change Policy* (Washington D.C.: Brookings Institution Press, 2004). Also: Ted Rutland and Alex Aylett, "The Work of Policy: Actor Networks, Governmentality, and Local Action on Climate Change in Portland, Oregon," *Environment and Planning D: Society and Space* 26, no. 4 (2008).

[68] Hulme makes a related claim, that the deterministic epistemologies of the natural sciences have overtaken humanistic approaches to the future, resulting in "climate reductionism," in which the future is reduced to climate: Mike Hulme, "Reducing the Future to Climate: A Story of Climate Determinism and Reductionism," *Osiris* 26, no. 1 (2011).

that plastic containers are better than glass containers, because the former are lighter and so less “carbon” intensive to transport, overshadows other concerns, such as the toxicity and non-bio-degradable nature of plastics.

Finally, given that shared understandings of the world are crucial to shaping it, the conclusion examines the agential connotations of the “Anthropocene.” The construction of the Anthropocene privileges human agency, especially in relation to climate change, in a manner that is more apt to reaffirm a CARBONized approach to climate. The conclusion proposes an alternative framework, the “Contemporary Carboniferous.” Quite differently, this frame challenges the biased presumptions of the realistic potential of human agency that explanations of the failure of climate politics overwhelmingly assume. If climate change cannot be ignored, then knowledge of climate change amounts to a suggestion that we are confronting material agency of a monumental scale.

Organization of the Dissertation

This dissertation examines the question of why climate change politics is characterized by intractability and divisiveness, and on the whole can be appraised as a failure to date. As a whole, it argues that “carbon” is not the key to fixing the climate problem, but rather CARBON is a symptom of why the climate problem is unlikely to be solved (at least not in a fashion that comports with how "climate change" has been constructed). The dissertation is organized as follows:

Carbon: The Dominant Discourse of Climate Governance

Chapter one demonstrates that "carbon" is the bulwark of the dominant discourse in climate governance. It gives a history of the "apolitical" development of "carbon," and its subsequent emergence at the heart of the discourse of climate politics. This account weaves together knowledge of "carbon's" material history (e.g. at the beginning of the universe and in industrialization) with the development of "carbon" as a scientific concept. The chapter gives the contours of the allotropes of C_{word}, and describes how the four assumptions of CARBON came to be attached to "carbon." In short the chapter demonstrates how "carbon" came to be the a/political force it is today.

Carbon Chains

Chapter two demonstrates that, at a global level, the CARBON-based *response* to climate change has resulted in a situation of "ecological paradox," in which a lot happens through the human preoccupation with "carbon," but little of consequence comes of it for the climate. This chapter presents a global ethnography of "carbon's" role in climate politics, through an "object tracking" of "carbon" to a variety of sites. These are presented as a collection of examples, ordered under 'C' headings (reflecting the reductivism of CARBON): calculation, consensus, combustion, complacency, etc. The combined effect is that CARBON supports a technocratic and "depoliticizing" approach to climate politics, overshadowing the potential of more radical, politicized counter-discourses.

Carbon Compulsion

Chapter three, grounded in the tradition of "problem definition" and "causal stories," examines mainstream explanations for the climate politics quagmire. Two findings of the analysis are stressed. First, the intractability of climate politics is typically explained as a failure of humans to properly exercise agency through deploying proper "carbon management" techniques. Second, this form of explanation keeps climate activists from coming to terms with the elephant in the room: the possibility that climate change will not be solved through the status-quo of "depoliticized" and technocratic CARBON, but rather that a solution would amount to a revolutionary shift in the current world order.

A World of Data and Models in the World

Chapter four asks: *what is occluded by CARBON's dominance?* It argues that ontological instability with regard to the nature of "reality" and agency underlie contention with regard to climate governance. This deeper source of conflict is captured through a tension between data and models that surfaces repeatedly and pervades different sites in climate politics. This deeper tension re(as)sembles older tensions between deterministic and contingent understandings of history, scholastic and nominalist theologies, and universalistic versus particularistic philosophies (all of which echo one another). The implication is that CARBON makes it more difficult to confront the underlying political-philosophical matters that the climate problem materializes.

The Contemporary Carboniferous

The dissertation's conclusion suggests an alternative to CARBON for thinking/doing climate politics: the Contemporary Carboniferous. This frame is useful for illustrating the epistemological and ontological constraints of climate change politics. It is also a retort to the (un)popular notion of the Anthropocene, which implicitly reinforces modernist privileging of human agency. In contrast, the Contemporary Carboniferous allows for the agency of diverse entities (e.g. particular human communities as well as coral reefs) to be accounted for across spatial and temporal scales, through tracing their interactions with "carbon" (or other) flows. By foregrounding the complex and entangled agencies transmitted through "carbon" in the Contemporary Carboniferous, rather than contradictorily disparaging and elevating the agency of the *anthropos*, *en masse*, in the Anthropocene, this framework enables approaches to global environmental problems and their governance outside of the restrictive nature/culture binary, and perhaps more amenable to other possibilities.

Carbon: The Dominant Discourse of Climate Governance

> *[That many deem policy mechanisms] such as carbon-trading and offset schemes [...] woefully inadequate [...] invites us to ask ourselves whether the intensely scientific primary framing of the issue, combined as this is with an intensely economistic imagination and framing of the appropriate responses, may engender profound alienation of ordinary human subjects around the globe from 'owning the issue' and thus from taking responsibility for it. Some authors have suggested that this leads to considerations about how, politically and ethically, as well as intellectually, we have framed 'the global climate problem', and whether there may be more justifiable and perhaps more effective framings of the issue which are still scientifically-informed.*[69]

Introduction

"Carbon" is an understandable and recognizable part of almost any discussion of climate change. That CO_2 emissions cause climate change is as widely known (if not as widely accepted) as the theory of gravity or the fact that vaccines help protect against certain diseases.[70] We might ask, however, why it is that *this* climate change fact has gotten so much discursive traction,[71] so much so that conversations that include it are often intensely political. "Carbon's" ability to link human activity (e.g.

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[69] Brian Wynne, "Strange Weather, Again: Climate Science as Political Art," *Theory, Culture & Society* 27, no. 2-3 (2010). 291-292.

[70] Of course, the political controversy that surrounds vaccinations bears a resemblance to that of regulating carbon emissions. In both cases, it is seldom the core principle that is contested. "Anti-vaxxers" often challenge the safety of vaccines on the grounds that vaccine additives might cause *other* health problems, point out that a vaccination against a disease only decreases and does not eliminate one's potential to contract it, or argue that "natural immunity" is preferable to disease resistance through vaccination. They tend not to challenge the principle that vaccines do reduce the number of cases of diseases, such as Polio, in the same way that the principle that carbon dioxide is a greenhouse gas does not itself tend to be the target of climate skeptics.

[71] I.e. there are many other dynamics at play, e.g. albedo, ocean acidification, or the potential for abrupt changes like the melting of large ice sheets.

combustion engines) with global warming is a self-evident but incomplete answer; more important, and overlooked, is "carbon's" ability to communicate the modern compulsion for "improvement" through "rationality." "Carbon's" reenactment of this paradigm helps explain climate change activism's lack of progress, because CARBON fosters the appearance that something is being or can be done to fix climate change, and that this is possible to do incrementally and within a status quo framework. In other words, CARBON makes it more difficult to confront the possibility that climate change poses a radical challenge to the status quo.

This difficulty persists despite the existence of statements that *do* seem to frame climate change in an apocalyptic idiom and that even, at times, present climate change as a challenge to capitalism.[72] These more dramatic assertions, however, coexist with a "dominant social construction of the scientific knowledge" that is incrementalist:

> in other words, to have constructed a representation of future climate change and its human causes which presents it as reassuringly gradual: in terms of rate and scale, within the bounds of policy manageability using existing cultural habits and institutional instruments: and requiring no more radical re-thinking of, for example, the powerful normatively-weighted cultural narratives of capitalist consumer modernity and its self-affirming (and other-excluding) particular and parochial imaginaries of 'progress', rationality, policy and knowledge.[73]

The incremental approach reflects certain features of the epistemology of the primary tool for the production of knowledge about global climate change: General Circulation Models. GCMs are "mathematically structured so that processes are

[72] Naomi Klein, *This Changes Everything: Capitalism Vs. The Climate* (Simon & Schuster, 2014).
[73] Wynne. 295-296.

represented by continuous, smooth differences,"[74] meaning that the potential for "scientifically plausible" tipping points and more dramatic (i.e. faster) changes (knowledge of which comes largely from outside of the world of climate modeling) are down-played.[75]

The gradualist orientation of the IPCC is, at least in part, a deliberate judgment of some at the IPCC to frame the science in a manner that they believe policy-makers will see as most "manageable." That is, the gradual visions of GCMs have been systematically emphasized by the IPCC, in comparison with the potential for abrupt and catastrophic changes, because the former is perceived to be easier to plan for and approach through policy than the latter.[76] The IPCC has envisioned "carbon" reduction to be the policy that follows from its reports. This is reflected in the language relating to "carbon" in IPCC Synthesis Reports. References to CO_2, GHGs, carbon dioxide, the carbon cycle, equivalent CO_2 concentrations, (etc.) are common in the sections of the reports devoted to scientific assessments of physical earth systems. C_{word} in its solitary state (e.g. without being attached to dioxide or cycle), appears rarely in those sections. In the segments of the reports that discuss economics, politics, and technical measures, however, C_{word} (alone) appears regularly and with increasing frequency in successive years.[77]

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[74] Ibid. 297.
[75] Ibid. 298.
[76] Ibid. 296.
[77] Author's analysis of: IPCC, "First Assessment Report," ((FAR), 1990); "Second Assessment Report," ((SAR), 1995); "Third Assessment Report," ((TAR), 2001); "Fourth Assessment Report," ((AR4), 2007).

This chapter elaborates upon the distinction between "carbon" and CARBON (which should be familiar to the reader from the glossary and the dissertation's introductory chapter.) In order to more precisely convey the different messages entangled with the word that is this chapter's centerpiece, it delves into the epistemological and ontological tangle that the allotropic portrayal of C_{word}, given in the glossary, captures more succinctly. To review, "carbon" [in quotation marks] refers to the spoken or written word, spelled c-a-r-b-o-n in English, as used uncritically in common parlance or general discourse in the context of climate change. CARBON [all caps] refers to a two-part dynamic in which underlying assumptions (see numbers one through four, noted below) about how the climate-changing world works are maintained through outward statements regarding "carbon." Another way to put this would be to say that "carbon" is the cornerstone of the dominant discourse of climate governance.

Similarly, others have noted the significance of "carbon" for climate politics. For example, Paterson has noted the "discursive framing of 'carbon' as the central organizing device for contemporary responses to climate change," is crucial to the mobilization of "carbon" for purposes of capital accumulation.[78] In a similar vein, Methmann has described how the idealization of a global carbon market contributes to making climate change protection an empty signifier that paradoxically allows for

[78] Matthew Paterson, "Governing Mobilities, Mobilising Carbon," *Mobilities* 9, no. 4 (2014). 572.

the perpetuation of the basic, climate-harming structures of the global economy.[79] Whittington states, "'carbon' refers not to a chemical per se, but to an imaginative space of global atmospheric relations rendered material."[80] Building on these reflections, this chapter explains how the discourse of CARBON emerged, and the dynamics through which it functions. To review, four assumptions are crucial to this discourse. These assumptions/aspirations regarding how the world does, should and should have worked tend to be called forth and fortified when climate activists speak of strategies to control "carbon."

1) reductive (especially quantifiable) strategies pave the path to a solution
2) agency (and hence responsibility) can be attributed through rational calculation
3) energy flows can be reordered on a massive scale without a social reorganization of comparable magnitude
4) solutions follow logically and easily from knowledge, which humans are progressively mastering

The ongoing reinscription and reinvigoration of these assumptions in and through "carbon," i.e. CARBON, may do a disservice to the goals of climate activism:

> the powerful rich-world policy focus, reinforced by commercial, industrial and media priorities, is restricted to greenhouse gas emissions and their control, while the cultural-economic habituated practices and global economic relations which 'enforce' those doubly destructive global conditions are backgrounded or even erased.[81]

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[79] Chris Paul Methmann, "'Climate Protection'as Empty Signifier: A Discourse Theoretical Perspective on Climate Mainstreaming in World Politics," *Millennium-Journal of International Studies* (2010). 23.
[80] Jerome Whitington, "Carbon as a Metric of the Human," *PoLAR: Political and Legal Anthropology Review* 39, no. 1 (2016). 46 .
[81] Wynne. 299.

The basis of Wynne's statement is an analysis of IPCC's framing of climate change that prioritizes GHGs as an approachable policy target. His assertion that this framing has the effect of backgrounding or erasing other practices and relations is a reasonable suspicion, but not substantiated in any detail in that article. This chapter lays the groundwork for a more detailed confirmation of Wynne's suspicion. CARBON discourse is an important mechanism in allowing those "destructive global conditions," to remain largely unchallenged. This chapter begins to make that case, and subsequent chapters take it up in more detail.

Part I of this chapter, *What is "carbon"?,* explains, briefly, the various allotropes of "carbon," giving examples of each. In addition, this allotropic catalog of C_{word} outlines the set of relations among the ways the term is used. Part II of the chapter, *Where did "carbon" come from?,* gives a brief history of "carbon." This section traces "carbon" as an artifact of, and in relation to developments in language, energy systems, and, most significantly, the production of scientific knowledge. It goes on to describe linkages between representations of "carbon" and its more spatially and temporally bounded manifestations, e.g. its place in the development of climate knowledge and its historical significance in relation to energy and economic systems, and provides one illustration of how these many linkages come together with the example of a brief history of "carbon" in US politics.

This approach draws from Bruno Latour's Actor Network Theory[82] and Timothy Mitchell's style of historical materialism. The chapter sketches what ANT might characterize as CARBON's "assemblage." That is, material things, concepts, and people all figure and are included in the explanation of how CARBON came to be, and the conscious agency of humans is not regarded to have greater explanatory power in the creation and maintenance of CARBON than the influence of parts of the assemblage that lack the capacity for intention. This "flat" ontology is more relevant here than ANT's methodology of (to be brief) describing a network. It is difficult to draw borders around where a network might begin or end, and the point here is not to do so, but to explain how CARBON has come into being (which necessarily involves describing the network that maintains it). Similarly, Mitchell's approach gives serious consideration to "material" factors, such as his explanation of the linkages between mosquitos and development in Egypt, [83] or democracy and oil.[84] In short, this chapter adopts the heterogeneous construction of agency that both Mitchell and Latour share. This joins Mitchell's more historicist orientation as a way to explain the development of a current, political phenomenon, with an ANT approach, which illuminates more of the present dynamics of CARBON—though there is certainly overlap in the application.

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[82] Latour, "On the Difficulty of Being an Ant: An Interlude in the Form of a Dialog."
[83] E.g. Timothy Mitchell, *Rule of Experts: Egypt, Techno-Politics, Modernity* (Univ of California Press, 2002).
[84] Timothy Mitchell, *Carbon Democracy: Political Power in the Age of Oil* (Verso Books, 2011).

Part III of the chapter, *What is CARBON?,* outlines the historical derivations of the four assumptions themselves (there is considerable overlap here with part II), noting how these assumptions affix to "carbon." This section also demonstrates how the four assumptions are entangled with a "carbon" based approach to combating climate change. The (quite literally) atomistic properties of "carbon" facilitate formulaic and reductive framings of climate, which can, conveniently for policy-makers and technocrats, be quantified and accounted for on paper or electronic spreadsheet. This rationalistic and calculative modus operandi is readily taken up in an atmosphere of liberalism (as seen, for example, in the ascription of carbon footprints) and a post-colonial order comprised of national economies, in which nation states (whose responsibility *vis a vis* climate can also appear to be neatly summarized in carbon reduction pledges and historical emissions tallies) are the key international actors. Following in this vein, the ability to sum up the (human) world's climate impacts through the succinct device of "carbon" also facilitates modernist imaginaries and projects, such as carbon trading schemes, through which knowledge of the world is harnessed to make it work "more as it should." In short, part III sums up how, when "carbon" is spoken, certain assumptions are usually implied.

What is "carbon"?

> *the spoken or written word spelled c-a-r-b-o-n in English, as used uncritically in common parlance or general discourse in the context of climate change; this usage implies at least (and usually more than) one of the following:*

$C_{element}$, $C_{dioxide}$, C_{GHG}, $C_{anthropos}$. That is, "carbon" has these four subtypes, though it may refer to more than one of these subtypes simultaneously. ("Low carbon" is its negative equivalent.)

In general speech, when we hear "carbon," we probably know, more or less, what is referred to from the context, even though "carbon" can be found in an overwhelming variety of settings, e.g. carbon markets, environmental protests, children's textbooks, eco-labels on consumer products, the balance sheets of numerous sustainable-development programs, bumper-sticker slogans, and politicians' campaign commercials. In all of these cases, "carbon" shares the same ostensible purpose of responding to global warming, but the politics that take shape from the affirmation of an environmental identity on a "pro carbon tax" bumper sticker is rather different from the politics of forest management by classifying trees as carbon sequestration devices that can provide valuable "ecosystem services." Part of what makes "carbon" such an incisive discursive object is this broad reach: the "carbon" in one setting is simultaneously the same and different as the "carbon" in other settings. However, there are important linkages, overlaps, and ambiguities in "carbon" speech. This shorthand ($C_{dioxide}$, etc.) allows these relations between allotropes to surface throughout the text. The shorthand serves as a reminder of ambiguous, conflicting meanings buried beneath the ostensibly simplifying and reductive clarity of "carbon."

"Carbon" can refer to many different things: a single atom; the molecule $C_{dioxide}$, a substance comprised of a certain configuration of $C_{element}$ atoms; a significant proportion of the matter that was present at the beginning of the universe;

a basic component of life; the main component in, as well as a shorthand for substances like coal, oil and natural gas that store energy that can be released to fuel modern life; in a state of atmospheric overabundance that threatens the health of the planet; the basis of and rationale for a tax (e.g. Australia's repealed "carbon tax"); the basic unit of monetized calculations of cap and trade schemes; a six-letter English word; a scientific symbol; etc. That all of these different things are also connected and, to different degrees, the "same" thing, has, on several occasions during the course of the development of this dissertation, been taken (by reviewers of early drafts and the like) as an indication of an imprecision in need of a solution and a short-coming of language. This diversity, complexity and ambiguity is, however, a significant, historical legacy that, in its details, sheds light on the status of CARBON in climate governance. This diversity underlies what Daalsgard has described as the term "enabl[ing] the commensuration of vastly different human practices."[85] The diversity of "carbon" fuels much of its discursive power: "carbon," therefore, draws attention to the significance of the signifying act.[86]

The case for an investigation of "carbon" has been made by Dalsgaard, who calls for "carbon [to be] taken seriously as an empirical phenomenon that involves different meanings across different relationships and contexts."[87] Dalsgaard points to

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[85] Steffen Dalsgaard, "The Commensurability of Carbon: Making Value and Money of Climate Change," *HAU: Journal of Ethnographic Theory* 3, no. 1 (2013). 81-82.
[86] Austin recommends that we look beyond the investigation of what an utterance *means,* and inquire into the *force* of the utterance. In other words, we should be concerned not only about the "accuracy" of a representation, but in what ways utterances constitute actions: J.L. Austin, "Performative Utterances," in *Philosophical Papers*, ed. Clarendon (1979). 251.
[87] Dalsgaard. 81.

the ability of "[carbon to] be seen as metaphor and as a figure for several different forms of circulation—most importantly, economic and natural (life)," which is consequential because, "as a circulating object, carbon is also implicated in the very transgression of spheres."[88] He elaborates, and also captures the complexity involved:

> Kyoto laid the groundwork for carbon in its financial form, the debate about global warming contributes to carbon's social form. However, there is a wide span in conceptualizations, from the debates about climate change and carbon accounting in scientific communities to the choices of lay consumers talking about carbon or CO2 emissions as a result of individual actions, which must be offset, and further to the details of permits (handed out by governments) and credits (earned through certified reductions of emissions) that can be traded or sold. In everyday discourse, the term "carbon" has almost become a catchall for all the different forms of chemical compounds and greenhouse gas emissions.[89]

The outline of "carbon" below wades into this complexity of meanings. Dalsgaard points to how "carbon" transgresses different spheres (economic, moral, social), creating uncomfortable and contentious commensurabilities (e.g. an offset making the CO_2 emissions of an industrial plant in Europe commensurate with the deployment of a new, more efficient development project somewhere in the global south). This dissertation gives a complementary exposition of "carbon."[90] The following section outlines the different, yet connected, meanings of "carbon." It demonstrates how these multiple meanings have been built expansively from one another. The combined

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[88] Ibid. 83.
[89] Ibid. 83.
[90] Lohmann's rendering of the logic of carbon markets in the form of algebraic equations elegantly conveys many of the same points regarding "carbon" described in this section. Mine is weighted toward discursive analysis, whereas his describes the political economy of the situation from a Marxist standpoint: Larry Lohmann, "The Endless Algebra of Climate Markets," *Capitalism Nature Socialism* 22, no. 4 (2011).

view gives a richer picture of what "carbon" is doing discursively, and how "it" is not encapsulated by any one of its meanings.

$C_{element}$ *an abundant chemical element fundamental to life on earth*

The matter we now call $C_{element}$ came to be known as such in 1789 when Antoine-Laurent Lavoisier,[91] a French experimentalist who is considered the father of modern chemistry,[92] published the first periodic table of the elements that included $C_{element}$.[93] $C_{element}$ is an innocuous and ubiquitous element, unlike plutonium-239 for instance. It is invisible, yet implicated in many indisputably important things, such as life, weather, chemistry, and breath. A minute percentage of the world's "carbon," a scant three-hundred billion or so metric tons out of an estimated one-hundred million billion tons, is implicated in global warming. It is, therefore, obviously not *all* of $C_{element}$ that is being referenced in discussions of "carbon." This allotrope, however, provides the etymological footing for the others.

$C_{element}$ facilitates easy transition from one post-material allotrope of carbon to another. The following explanation of the scientific underpinning of "carbon farming" is an illustration:

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[91] His inquiry was embedded in the naturalist philosophical mode of knowing that was developing in the wake of the rise of Nominalist theology (described in chapter four), and during the period we have come to describe as modernity, the relevance of which is described in later sections.

[92] Madison Smartt Bell, *Lavoisier in the Year One: The Birth of a New Science in an Age of Revolution (Great Discoveries)* (WW Norton & Company, 2010).

[93] Antoine Laurent Lavoisier, *Elements of Chemistry, in a New Systematic Order: Containing All the Modern Discoveries* (Courier Corporation, 1965 (1789)).

> Carbon is the key ingredient to all life. It is absorbed by plants from the atmosphere as carbon dioxide and, with the energy of sunlight, converted into simple sugars that build more plant matter. Some of this carbon is consumed by animals and cycled through the food chain, but much of it is held in soil as roots or decaying plant matter. Historically, soil has been a carbon sink, a place of long-term carbon storage. But many modern land management techniques, including deforestation and frequent tilling, expose soil-bound carbon to oxygen, limiting the soil's absorption and storage potential.[94]

The article goes on to describe how "carbon farmers" could be encouraged to do more "carbon farming" if government incentivized it by issuing them carbon credits. In short, discussions of "carbon's" role in climate change can both be reduced to, and expand from, $C_{element}$.

$C_{dioxide}$ *shorthand for carbon dioxide (in the context of climate change)*

Carbon dioxide is the most significant of the greenhouse gases,[95] and the "global warming potential" (GWP) of other greenhouse gases is expressed in terms of their "carbon equivalent."[96] That $C_{dioxide}$ was chosen as the denominator in these equations[97] means that another GHG, or a combination of GHGs, might be referred to as "carbon." Moreover, another of the GHGs that $C_{dioxide}$ stands in for, itself contains

[94] Sally Neas, "What's a Carbon Farmer: How California Ranchers Use Dirt to Tackle Climate Change," Yes! magazine, http://www.yesmagazine.org/planet/whats-a-carbon-farmer-how-california-ranchers-use-dirt-to-tackle-climate-change-20160429.
[95] Methane and nitrous oxide are other notable GHGs. Time makes this equivalency ontologically troublesome, as the GWP is per a specified time period (typically twenty, fifty or one-hundred years), but the various GHGs have different atmospheric longevities, so a different timeframe would change the relative weight of the different GWPs, as would the inclusion of water vapor, which has a more substantial, but less controllable, warming effect than other GHGs.
[96] Donald MacKenzie, "Making Things the Same: Gases, Emission Rights and the Politics of Carbon Markets," *Accounting, Organizations and Society* 34 (2009).
[97] For a detailed description, see: ibid.

$C_{element}$: methane (CH_4). Under a 100-year time frame, Methane has 28 times the GWP of $C_{dioxide}$[98] (comparing molecules to molecules); however, CO_2 is the greatest contributor to global warming because of the relative quantity (more molecules of CO_2 than CH_4) emitted. In turn, this equivalency is more complicated than it first appears: CH_4 in the atmosphere can oxidize and turn into CO_2. A number of minor GHGs contain $C_{element}$ as well, e.g. perfluorocarbons (PFCs).[99]

There are many more complicated nuances of atmospheric chemistry that can be figured into calculations of GWP (e.g. the many other compounds in the atmosphere and how they mix together over time), and the formulas for calculating GWP are periodically revised. The GWP for marketized "carbon," however, ever since the CDM was established under the Kyoto Protocol, continues to be calculated using the formulas from the Second IPCC (Intergovernmental Panel on Climate Change) report.[100] In other words, carbon credits are based on older determinations of GWP: their value is not recalculated when the GWP formula is refined. Out of the calculation of GWP, other GHGs can be incorporated in carbon credits or proposals

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[98] IPCC, "Climate Change 2014 (5th) Synthesis Report Summary for Policymakers," (2014). 3. http://ar5-syr.ipcc.ch/

[99] The predecessor of GWPs are ODPs, Ozone Depletion Potential. The two, however, are tightly intertwined, as later discussed in this chapter's section on "the ozone antecedent."

[100] The Kyoto agreement set up a UN regulated emissions market, which allows for industrialized signatory countries to meet their emissions reduction targets, even if not all of those reductions are actually domestic, through purchasing carbon offsets, typically from developing countries. The first commitment period created targets for six GHGs: carbon dioxide (CO_2); methane (CH_4); nitrous oxide (N_2O); Hydrofluorocarbons (HFCs); Perfluorocarbons (PFCs); and Sulphur Hexaflouride (SF_6). Kyoto's second commitment period added nigrogen trifluoride (NF_3). A number of other GHGs are not covered by the Kyoto protocol because they are also ozone depleting chemicals that were covered by the prior Montreal Protocol.

for a carbon tax. The standard carbon credit is based on the GWP of 1000 tonnes of CO_2.[101] The expansion and equivalencies from these simple starting points go on:

> But CO2 is merely one of several appearances and thus one of several objectifications of carbon. Offsets, permits, and credits may appear to refer to the same thing when it comes to emissions trading on the market, but outside the market, they refer to many different processes, actions, and contexts.[102]

In other words, marketized carbon (credits and the like) allows for further equivalency that expands well beyond the molecular realm.[103] Carbon credits represent a certain quantity of $C_{dioxide}$, and $C_{dioxide}$ acts as a metonymical stand-in for other GHGs, or, at times, for all the GHGs at once. Down the line, (in the context of global warming) $C_{element}$ is the metonymical stand-in for $C_{dioxide}$.

C_{GHG} *shorthand for emitted or potentially (not) emitted greenhouse gases, whether or not they are from "natural" sources*

This is a rather simple expansion built on the definition of $C_{dioxide}$ outlined above. At times, "carbon" refers to GHGs writ large, and not $C_{dioxide}$ in particular; it is the controllable, i.e. (potentially) anthropogenically regulated warming that is of concern. This explains the exclusion of water vapor from GWP, as it is considered to be largely a "natural" factor that is, for the most part, not subject to human control.

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[101] GWPs, as calculated in the second and fourth IPCC reports, (IPCC 1995; 2007) are as follows: methane, 21/25; nitrous oxide, 310/298; the class of HFCs, 150-11,700/12-14,800; the class of PFCs, 6,500-9,200/7,390-12,200; SF6, 23,900/22,800. In addition, there has been debate as to the value of GWP as a metric, as well as proposals for developing "better" metrics, e.g.: Miko UF Kirschbaum, "Climate-Change Impact Potentials as an Alternative to Global Warming Potentials," *Environmental Research Letters* 9, no. 3 (2014).
[102] Dalsgaard. 83.
[103] Whereas Dalsgaard treats "carbon" as object, this project goes further, allowing "carbon's" capacity to act as both object and subject to be present.

The reason for highlighting and including actually, potentially, and potentially not emitted GHGs here is that carbon credits and offsets are based on the premise of valuing actions not taken that, arguably, could have been. In other words, these markets operate out of a subjunctive grammar.

Consider the paper "Scientific case for avoiding dangerous climate change to protect young people and nature,"[104] authored by an interdisciplinary group led by prominent climate scientist James Hansen and replete with complicated figures, which demands a 6% cut in annual CO_2 emissions. The wording is didactic, and through reductionism, the message is that the solution is simple—even though it is not obvious whether $C_{dioxide}$ in this case includes C_{GHG}. These comparisons are common, superficially clarifying, but also obfuscatory and confusing.

Another example, from a Denver Post guest commentator, sums up a US Forest Service analysis of the "climate pollution" that would result from a proposal to open a particular roadless area to mining by coal companies: "The coal from this single decision could emit an additional 130 million tons of carbon over several decades. That's as much carbon as people produced in the entire state of Colorado in 2010."[105] In an assertion like this, it is unclear whether the speaker means only $C_{dioxide}$, all C_{GHGs}, or whether the cooling effect of any negative feedbacks have been subtracted from the warming effect of the "carbon." Notably, these different substances would also have warming and cooling effects on different timeframes,

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[104] James Hansen et al., "Scientific Case for Avoiding Dangerous Climate Change to Protect Young People and Nature," *arXiv preprint arXiv:1110.1365* (2011).
[105] Mark Squillace, "Guest Commentary: Managing Federal Minerals as If Carbon Emissions Mattered," *The Denver Post*, December 11 2015.

which adds further ontological instability to the quantity of "carbon" emitted by "the people of Colorado in 2010." C_{word} overshadows such ambiguities. Moreover, ambiguity seems to be the rule rather than the exception: the majority "carbon" reductions through UN CDM certified emissions reduction permits are for projects that aim to reduce N_2O or HFCs, not CO_2.[106]

$C_{anthropos}$ *shorthand for all "anthropogenically" emitted or potentially (not) emitted greenhouse gases.*

The notion of anthropogenic greenhouse gas emissions contains a great deal of ontological instability, as well as unresolvable epistemological conflict about how to measure such a thing. Consider the oddity that human breath is generally not factored into calculations of (implicitly human) carbon footprints, [107] yet methane emissions from cattle often *are* included.[108] Dalsgaard relegates the discussion of which emissions count as "human" to a footnote:

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[106] Patrick Bond, "Emissions Trading, New Enclosures and Eco-Social Contestation," *Antipode* 44, no. 3 (2012). 690.

[107] The overview given of carbon calculators given by Padgett et al describes the types of metrics found in carbon calculators, e.g. heating fuel type, diet, type of car, miles traveled, electricity consumption, etc., but nowhere do they mention human breath—likely because breath is an ultimate necessity, even more so than heat or lighting. Padgett et al also find that there is a great deal of variety in how carbon calculators compute individual carbon footprints, as well as insufficient disclosure of the formulas assumptions that go into their design, resulting in inconsistent results between calculators: J Paul Padgett et al., "A Comparison of Carbon Calculators," *Environmental impact assessment review* 28, no. 2 (2008).

[108] Comparisons of the carbon footprints of dietary choices, particularly the greater impact of meat eating—and particularly cattle—versus vegetarian or vegan diets, are commonplace, e.g.: Damian Carrington, "Giving up Beef Will Reduce Carbon Footprint More Than Cars, Says Expert," *The Guardian*, July 21 2014. The large climate impact of cattle is attributed to a number of factors, such as land and water use, but also to their inefficient, methane

> Non-human actions may also emit carbon, of course. […] However, as carbon markets are based on the delimitation of human emissions, I only briefly touch on the non-human in this article.[109]

This elision is likely a response to the need to frame climate policy and “carbon” as controllable by humans,[110] i.e. to emphasize the agential capacity of humans both as causes and possible solvers of the climate problem. In so doing, however, the difficulties of such agential ascriptions—and their ramifications for climate politics—are glossed over. Daalsgard seems to acknowledge this difficulty:

> The distinctions that are drawn between human and non-human in terms of defining the agency behind emissions would be worth exploring as one of the problems engendered by the objectification of carbon.[111]

That, in many respects, is what this dissertation goes on to do. As a first step, the allotropic catalog here allows for $C_{\text{anthropos}}$ to be present throughout the text, and chapters three and four delve into issues of agency, and its relation to the *anthropos,* in greater detail.

Where did “carbon” come from?

An extraordinary complexity and history underlies and supports the outward simplicity and straight-forwardness that “carbon” more typically conveys. This section presents a historical account of "carbon," highlighting the co-produced links

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producing digestive systems—e.g. “California wants to limit the amount of greenhouse gas emitted by belching and farting of 5.5 million cows”: Oliver Milman, "Dairy Groups Blast Methane Reductions: “Cows Exple Gas So They Don’t Explode”," ibid., August 2016 2016.

109 Dalsgaard. 83.

110 This point is elaborated upon in the introduction of chapter three.

111 Dalsgaard. 83.

between knowledge (particularly the scientific revolution), political economy, energy systems (e.g. wood based to fossil based fuels), and the climate (e.g. atmospheric CO_2 measurements, global temperature and humanity's influence upon and response to climate changes pre and post industrial revolution, and climate science).

The dawn of modern Western science is an especially influential period in the development of the identity of “carbon” that laid the groundwork for the “carbon” we know today. Because “carbon” has a history that is ingrained in both science and politics, the story of “carbon” given here will necessarily review some relevant history of the configuration of science and politics in relation to one another. What will become apparent is that the formation of “separate” spheres of science and politics depends on a particular epistemological and ontological configuration. “Carbon’s” history is itself embedded in the relationship between the ordering of society (“politics”) and the perception of order in nature (“science”). These efforts at ordering, however, are not separate. For example, socio-technical order must have mechanisms for establishing what forms of knowledge production and the resulting knowledge are to be regarded as legitimate.[112] The prevailing socio-technical order, as will be outlined below, is characterized by a naturalist philosophy of knowledge that depends on a realist ontology and an epistemology based in the principles of the experimental method.[113]

112 Sheila Jasanoff, *States of Knowledge: The Co-Production of Science and the Social Order* (Routledge, 2004).
113 During the US presidential campaign in 2016, and in the wake of the election of Donald Trump, “truth” and “facts” have themselves become a political issue of much political discussion and discord. As different groups largely self-segregated to different “media-

Science/Politics

No account of climate politics would be complete without plentiful attention to "carbon," with its talk of carbon taxes, carbon markets, decarbonization, comparative carbon footprints and the like. (Oddly, as explained in chapter four, "carbon" is not essential within many discussions of climate science.) Yet, "carbon" is customarily associated with the "science" side of the science/politics binary, with talk of "carbon" in relation to policy being a relatively recent phenomenon. This incongruity points toward the construction of the boundary between science and politics as significant to "carbon's" development. "Carbon's" association with science is a constituent element of its politics, and the science and politics of "carbon" have never been terribly separate, which is true of the relationship between "science" and "politics" writ large.

The naturalist philosophy[114] took its first serious step toward supplanting the previously dominant epistemology in Europe in the 17th century when Galileo Galilei made his astronomical theories public. Galileo observed the night sky with the help of a telescope and meticulously recorded his observations. Reasoning from those inductively gathered observations, he concluded that the organization of the heavens

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bubbles," they also relied on "different facts." Media "fact-checkers" repeatedly found that the majority of Trump's assertions to be false, often blatantly so, which only seemed to strengthen his support. This development potentially indicates that socio-technical order may be undergoing a significant reordering.

[114] I am following the nomenclature used by: Jonathon W. Moses and Torbjorn Knutson, "Ways of Knowing: Competing Methodologies in Social and Political Research," *Palgrave Macmillan* (2007). See especially page 32. Moses and Knutson also include logical positivism, rationalism and empiricism under the umbrella of naturalism. What these share is the belief that the real material world that can be observed through the senses and is ordered by general principles.

was quite different from church doctrine. The theology of the Church was based on a deductive model that had been affirmed and established in authoritative texts for several centuries,[115] and had been especially influenced by medieval scholars who had tried to reconcile the logical reasoning of ancient Greek philosophy in the tradition of Aristotle with the revelations of scripture.[116] The Church condemned Galileo not only for his radical propositions (giving further support to Copernicus' theory of heliocentrism), but also for the politically revolutionary epistemology that he used to come to his scientific conclusions – curiosity was deemed a mortal sin.[117]

Before Galileo, Sir Francis Bacon argued for the use of inductive logic and set the foundation for what has become known as the "scientific method" in *Novum Organum.*[118] Bacon confronted deductive Aristotlean epistemology on the grounds that the approach only affirmed established knowledge, whereas sensory observation of nature, especially as gathered inductively through experimentation, could produce new knowledge.[119] The experimental method is preferred by naturalists and considered "the most scientific" because of the ability to control surroundings and so seemingly observe only the individual entities hypothesized to relate to one another – i.e. in a limited context.

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[115] Ibid. 19.
[116] Michael Allen Gillespie, "The Theological Origins of Modernity," *The University of Chicago Press* (2008). 20-21.
[117] Stephen Greenblatt, *The Swerve: How the World Became Modern* (WW Norton & Company, 2011). Chapter 1 of unpaginated ebook.
[118] Francis Bacon, *Novum Organum* (Clarendon press, 1878).
[119] Moses and Knutson. 22.

Building on Bacon's ideas, David Hume argued that causality cannot be known with complete certainty, because it is necessarily the product of human imagination, which seeks to explain the relationship between sensory observations.[120] In other words, theories are based on inference from observations, not from observations themselves. Therefore, although scientific philosophy privileges inductive reasoning, the scientific method has come to specify a proper role for deduction as well. Karl Popper[121] provided a model for how deductive and inductive reasoning are to work together. According to Popper, observation is dependent on theory and so it is not possible to rely purely on induction. Put differently, observation is always guided by theory, and theories are to be tested and compared with one another. For Popper, then, science is not quite the quest for truth, but a process for building theories, which are to be judged according to their explanatory power. Popper's explanation of scientific philosophy is now regarded as the definitive summation of the principles of naturalistic philosophy that undergird the scientific method.[122]

"We can observe order in nature" is a reasonable distillation of the naturalist philosophy that the scientific method enacts. Where does this concern with order come from, and why are we looking for it in nature? Why are *we* (humans) tasked

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[120] David Hume and Charles William Hendel, *An Inquiry Concerning Human Understanding*, vol. 49 (Bobbs-Merrill Indianapolis, 1955).
[121] Karl Popper, *Conjectures and Refutations: The Growth of Scientific Knowledge* (routledge, 2014).
[122] Moses and Knutson. 44.

with observing? Why were the authors of the scientific method so consumed by nature in the first place?

An important part of the answer harkens back to 1660s England, when Robert Boyle instantiated this dichotomy through his practice of experimentation. Boyle conducted experiments – most famously by using the "air-pump" – that exemplified a naturalist philosophy of knowledge. Boyle did not explicitly discuss, explain or justify the philosophy underlying the experimental method. Rather, he "*showed* the new natural philosopher how he was to proceed in dealing with practical matters of induction, hypothesizing, causal theorizing, and the relating of matters of fact to their explanations."[123] Experiments alone could not, however, produce matters of fact: they had to be witnessed and attested to by others in the credible community of experimentalists.[124] For instance, Boyle not only performed experiments at the Royal Society of London, but would advertise that credible men, the more the better, had been witnesses. That is, the development of the experiment as a legitimate mode for producing knowledge depended not only on the construction of devices like the air-pump, but the construction of a social organization that would provide a space for producing credible knowledge about nature.

Put differently, experimentally produced knowledge did not gain social acceptance simply by virtue of its intrinsic merits.[125] Rather, experimentalism was a social practice that developed within a larger social and historical context – the most

[123] Steven Shapin and Simon Schaffer, *Leviathan and the Air-Pump: Hobbes, Boyle, and the Experimental Life* (Princeton University Press, 1989). 49, emphasis added.
[124] Ibid. 55-60.
[125] Ibid. 13.

pressing of which was the upheaval of the English Civil War. Experimentation was "to rule out of court those problems that bred dispute and divisiveness among philosophers, and they were to substitute those questions that could generate matters of fact upon which philosophers might agree."[126] Yet, this philosophical assent was created not because experimentally produced knowledge was self-evidently superior, but because it was created along with a social space in which it was regarded as such.

The culture of the laboratory experiment was insular and exclusive, as "the space was restricted to those who gave their assent to the legitimacy of the game being played within its confines."[127] The agreement within this scientific community stood in stark contrast with the social disorder that had tormented Reformation England, in which contests between monarchs and the challenge of parliamentary rule were entwined with metaphysical and theological disputes. By creating a forum dedicated to searching for answers to questions about nature, Boyle had seemingly removed a source of conflict from the contentious atmosphere of society itself.

Thomas Hobbes, writing at the same time as Boyle, took issue with Boyle's experimentalism. Hobbes was especially troubled by Boyle's assertion that the air-pump created a "vacuum," a term which had been the subject of metaphysical discussion but for which Boyle gave no philosophical justification.[128] Their disagreement as to the existence and meaning of "vacuum" was rooted in a deeper disagreement over whether there is but one order or if order can be divided into

[126] Ibid. 46.
[127] Ibid. 336.
[128] Ibid. 81.

separate social and natural realms. In other words, Boyle and Hobbes' disagreement about how to properly know nature was also an argument about the relationship of social order to knowledge,[129] and the natural inquiries of each offered a different approach as to how social order could be restored in England. Hobbes, in keeping with his appreciation of the deductively derived truths of geometry, did not distinguish between order in nature and order in society, and contended that peaceful order could therefore be attained through total assent of the populace to the rule of a single sovereign. By contrast, Boyle's solution to the problem of order during the Restoration was through "withdrawing [natural philosophy] from contentious links with civic philosophy."[130]

The scientific space that was created as part of Boyle's project could not produce its facts (which were probabilistic and containing degrees of un/certainty, as opposed to Hobbes' absolute truths) without also producing the assent of the scientific community. This assent indicated the legitimacy of the knowledge and its producers, so that once facts were established, they could also be deployed and contribute to the improvement of society. Boyle's position that the physical world could be studied apart from society (even if for society's sake) was tantamount to an assertion that the social order *should* be organized in response to this division as well. That Hobbes' *Dialogus Physicus* (1661) was for the most part conveniently forgotten

[129] Ibid. 15.
[130] Ibid. 21.

for most of the nineteenth and twentieth centuries,[131] until resurrected by Shapin and Shaffer,[132] is one indication of Boyle's success in the "removal" of science from society.[133]

In order to conclude that patterns in nature constitute useful knowledge for ordering society, it is also necessary to assume that those patterns are relatively stable, as there would be no point in changing the social order in response to knowledge that is perceived only to apply to the past. Naturalism builds theories out of regularities observed to fit the past, and assumes that these patterns can tell us something about the future, which has not yet materialized and so is not observable. Naturalist science, however, is also beholden to the principle of falsification. A theory can be disproved by a single instance of nonconformity, but no theory is verifiable because general claims would have to be tested against every potential example of their applicability, which is not possible in a vast world.[134] In other words, facts that are arrived at through processes of induction and observation (as opposed to, e.g. deductively derived mathematical formulas) cannot be proven to be true.

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[131] Unlike his enormously influential *Leviathan* (1651), which has a more overt focus on political philosophy and is customarily read as such, *Dialogus Physicas* does not itself rely on this distinction between scientific and political order. Ibid. 92-107.
[132] Ibid. 8.
[133] Of course, as Latour and others have illuminated at length, the separation of the social and the scientific into separate realms is an illusion, albeit one of great political consequence. See: Bruno Latour, *We Have Never Been Modern* (Harvard University Press, 1993).
[134] During the 1930s a logical positivist school developed, arguing that truth claims should be evaluated according to verifiability. They were taken to task by Karl Popper, and falsifiability, rather than verifiability, is now the accepted scientific principle: Moses and Knutson. 43.

The "culture of no culture"[135] of science is calibrated in accord with the dichotomy between social and scientific that governs society writ large. Science is, nevertheless, a social practice, and scientists work according to the culture of their tribe.[136] Latour and Woolgar's ethnography of "laboratory life" describes one manifestation of this Platonic vision of the relationship between science and society: scientists detaching the facts they produce from the conditions of their production. In order to do this, scientists rely on the distinction between social and technical, and it is a constituent part of how they go about their work. Scientists themselves accept the facts that other scientists have produced, importing such facts into their own labs through "black-boxing" the conditions of the production of the fact. Yet, this social process of production necessitates defining and maintaining what constitutes the distinction between social and technical, and to regard it as self-evident, rather than as resulting from a social process. The authors note that, for facts to be produced, the scientist must also assume "that order somehow preexists its 'revelation' by science or in some way results from something other than disorder."[137] The question of whether the world is fundamentally ordered or disorderly is metaphysical, not scientific. (Therefore, metaphysics are the starting point for the examination of climate models, data and politics in chapter four).

Climate change is in large part defined as an emergent phenomenon, the effects

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[135] Sharon Traweek, *Beamtimes and Lifetimes: The World of High Energy Physics* (Cambridge: Harvard University Press, 1988).
[136] Bruno Latour and Steve Woolgar, "Laboratory Life: The Consturction of Scientific Facts," *Princeton University Press* (1986 (1979 1st ed.)).
[137] Ibid. 247.

of which are largely yet to be seen. Given that climate change science is particularly concerned with predicting an indeterminate future, climate models do more than observe the world out there; they are sophisticated imaginings of what the world out there may come to be. They also may shape what that world comes to be, as regulating human interaction with "carbon" is the proposal of climate science for how society should be reordered. The contingent nature of climate change, however, also makes it awkward to attribute the firm ontological status of 'fact' to predictions of the characteristics of anthropogenic climate change. In a similar vein, "the endemic *Achilles' heel* of IPCC has been the fundamentally social character of the aim to extract meaning from disciplined observation of nature and its human-social guests."[138] In short, the naturalist underpinning of the "separation" of science from politics also becomes the ground on which climate science is politicized.

Latour, perhaps inadvertently, seems to argue that "carbon" is key to this politicization. His response to CO_2's concentration in the atmosphere surpassing 400ppm for the first time in 2.5 million years is:

> It is impossible to read such a statement as an 'objective fact' contemplated coldly from a distant place… There is no distant place anymore… because the very notion of objectivity has been totally subverted by the presence of humans in the phenomena to be described—and in the politics of tackling them.[139]

Part of the magic of "carbon" is its ability to invoke the politically persuasive power of allusions to "fact," even in the absence of epistemological discussions of how

[138] Wynne. 291.
[139] Bruno Latour, "Agency at the Time of the Anthropocene," *New literary history* 45, no. 1 (2014).1-2.

climate knowledge is made. As Latour makes evident, however, “carbon” also simultaneously illustrates how, in the sense that science and politics cannot be neatly separated, “Hobbes was right.”[140] That is, when humans observe the crossing of the 400ppm threshold, they are implicitly observing themselves and the socio-scientific imperative that they consider past and future human-nature re-actions.

The Matter of Signification

The epistemological components of naturalism described above rely on a “realist” ontology. That is, naturalism conceives of a real world “out there,” separate from the observer. This objectivity is the justification for regarding knowledge gleaned through deploying the naturalist philosophy (as well as its producers) as authoritative. Naturalism’s realist ontology also entails a belief that language is separate from and capable of accurately representing the world it describes, as experimental observations cannot be captured and communicated without precise language. This assumption is codified in the correspondence theory of truth, which holds that a statement is true if the linguistic rendering of the world corresponds to the world out there.

The “obvious” explanation for how “carbon” became the dominant discourse in climate governance is “because the science said so.” “Carbon’s” attachment to climate science is not, however, a sufficient explanation. For one thing, it is carbon dioxide, not “carbon” alone, that is a greenhouse gas. Yet, political discussions and

[140] This is the concluding line of Shapin and Schaffer. 344.

bumper stickers [image 3, page 72] reference carbon footprints and carbon taxes, not carbon dioxide footprints or carbon dioxide taxes. For another thing, carbon dioxide is only one of several greenhouse gases, but we do not speak of lowering, for example, our nitrogen dioxide footprint. Therefore, the physical action of carbon dioxide as a greenhouse gas does not itself explain the creation of "carbon" as a political signifier.

Image 3) Bumper stickers, "Carbon Tax: Market Driven Energy Independence," and "Carbon Neutral Vehicle," affixed to a Toyota Land Cruiser in California

Words and matter both have histories, and it was not until the year 1789 (as discussed above) that the matter we now call "carbon" came to be described with its present signifier.[141] If we do not accept the premise that signifiers can be separated from their significations, "carbon" did not exist before that moment. On the one hand, according to an unapologetically whiggish[142] position, "carbon" has existed all along, so it would not be a problem to use the word to describe nature in the distant past. On the other hand, to take a radically anti-whiggish position would mean that nothing should be described as "carbon" before C_{word} came to mean what it does. With some explanation, however, it is reasonable to use C_{word} to describe matter that antedates its signifier. The approach taken here is in keeping with the solution to the problem of whiggishness that Latour describes: i.e., when extending the signifiers of scientific facts to the description of older phenomena, we also acknowledge the labor that went into producing them. In this manner, "carbon" can travel back in time but the network of its production may not go back with it.[143]

"Carbon's" etymological origins are rooted in the latin *carbo* and *carbone,* which refer to 'coal' or 'charcoal.' The first definition of "carbon" given in the Oxford dictionary of English[144] describes it as "the chemical element of atomic number 6." Before explaining the significance of $C_{element}$ properties, however, a warning is in order: this description relies on curious grammatical devices that

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[141] Lavoisier.

[142] "Whiggish" interpretations of older knowledge evaluate it according to the state of knowledge at present. For example, science that helped make "progress" toward the current state of knowledge might be regarded as "innovative," while older knowledge that is in disagreement with the present consensus would be considered "misguided" and not "real" knowledge at all.

[143] Bruno Latour, "On the Partial Existence of Existing and Nonexisting Objects," *in Biographies of Scientific Objects, Daston, L., ed.* chapter 10, no. University of Chicago Press (2000).

[144] Oxford English Dictionary, *"Carbon, N."* (Oxford University Press, http://www.oed.com/view/Entry/27743?result=1&rskey=FI53vy&).

explain the workings of $C_{element}$ through "anthropomorphic" devices[145] —i.e. agential language. As Latour notes, the linguistic "animation" of scientific objects (or actants) is not avoidable, despite the ontological supposition of science that these objects lack agency,[146] as:

> what makes scientific accounts so well suited for a semiotic study is that there is no other way to define the characters of the agents they mobilize but via the *actions* through which they have to be slowly captured… what they *are* [is] defined long after their *performances*—that is, what they *do.*[147]

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[145] An extreme example comes from *Tyler Volk, Co2 Rising: The World's Greatest Environmental Challenge (MIT Press, 2008).* In this book, the global carbon cycle is explained through telling the stories of several "individual" carbon atoms: Coallene comes from coal; Oiliver comes from oil; Icille is trapped in an Antarctic ice core, etc. In short, these "individual" atoms are portrayed as actors—agents, in a very familiar sense, thanks especially to their personification. This points toward an ontological dilemma that is taken up in more depth in chapter four: i.e., that "carbon" makes it unclear to what extent agency and responsibility rests with humans, or with "carbon" atoms themselves (i.e. to nature or God).

[146] Scientists are frequently sensitive about attributing "human" characteristics to atoms. *Eric Roston, The Carbon Age: How Life's Core Element Has Become Civilization's Greatest Threat (2008).* For example, in a review of the aforementioned book, a reviewer chides the Roston for "anthromorphisms" like "the enmity between hydrogen molecules and helium atoms." Fred Pearce, "Review: The Carbon Age by Eric Roston," *New Scientist* 198 (2008). Curiously, Pearce commends (only a couple of sentences later) Roston's statement that "[i]ndustry needs to find a way to live inside the biosphere" as an example of how *Carbon Age* makes a "compelling case" regarding climate solutions. If "an" entity as amorphous as "industry" can be expected to find a way to exert agency, then it is, arguably, reasonable for entities as discrete as particular atoms and molecules be described as having feelings that guide their actions with regard to one another. Helium does not want to bond. "Enmity" is an artful way of describing a chemical relationship that quite certainly exists, as researchers have established as a basic scientific principle and can describe with precision. The concept of "industry," quite differently, is distributed, containing workers, owners, suppliers, distributors, machines, balance sheets, technology, rival businesses, competition, forces of supply and demand, etc. The reason it is common to describe such an entity, implicitly, as capable of exercising (conscious) agency is, of course, the presence of people within the industry scenario, and their absence in the case of atoms. Taken together, all of this points to a difficulty with regard to conceptualizing collective agency, which would take us in the direction of fundamental, theoretical questions with regard to governance, e.g. whether the "will of the people" exists, whether individuals can be wrong in their determinations of their "interests," or how the "common good" is to be determined.

[147] Latour, "Agency at the Time of the Anthropocene." 11.

This dependence on language that ascribes desires, preferences and actions to material substances is the norm among chemists (and other physical scientists), and this form of language is replicated here.

$C_{element}$ is abundant, $C_{element}$ atoms bond readily, and those bonds tend to be quite stable. $C_{element}$, in common with most elements in their "isolated atomic state,"[148] does not have a full outer shell of electrons, and the outer shell electrons are responsible for most of an atom's chemical reactivity (nuclear reactions are a different can of worms). This un-full outer shell means carbon *"*struggles*"* to get a full one by borrowing electrons from other atoms—i.e. forming bonds ($C_{element}$ doesn't "like" losing electrons).[149] Although chemistry's understanding of $C_{element}$ involves what might be coined an individualistic portrayal of "its" traits, "free" $C_{element}$ atoms rarely exist as such, due to their drive to bond.[150] As one chemist said, "carbon isn't happy by itself."[151]

"Carbon," considered as the overall effect or sum of its meanings and connotations in different contexts, entails a liberation of "signifier" from "signified." CARBON discourse assumes that $C_{element}$ (and material "carbon") maps fairly well onto "carbon" accounting plans and programs. But CARBON discourse itself becomes reified to such an extent that the trueness of its representation of "carbon"

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[148] The vast majority of elemental atoms do not spend time in this solitary state without some work on the part of chemists to put them there (e.g. with the assistance of liquid nitrogen).
[149] It does not seem, however, that chemists are apt to think of $C_{element}$'s agency being challenged, i.e. as in a state of perpetual bondage.
[150] $C_{element's}$ lack of what could be called "individual freedom" is hardly unique to the element: Noble gases are the only atoms generally possessed of this liberty.
[151] This account is informed by discussions with PhD candidates in chemistry at University of California, Santa Cruz.

becomes less and less important. CARBON is able to do its work through its maintenance of modernist assumptions—as an expression of faith therein—and the assumption that "carbon" can be reconfigured through knowledge of it (i.e. as a result of the process of representing it). Criticisms of the lack of representativeness or functioning of "carbon" schemes (see chapter two), from this perspective, can always be countered by the argument that calculations, estimations, techniques and procedures can be improved and more accurately represent "actual" "carbon." Therefore, fidelity to "actual carbon," i.e. fidelity of signifier to signified in the straight-forward sense, is not necessary to the continuance of the discourse.

Climate Science/Politics

Naturalists make an assumption about the character of the world out there – that it is ordered – which necessarily influences the character of their representations. Naturalist inquiry looks for patterns in nature, and so the representation of reality that it produces is simpler and less messy than the reality it first observes. The founders of naturalist philosophy, perhaps none more than Descartes, thought the world (external and observable by the senses), to be simple beneath its apparent complexity.[152] Naturalists make knowledge by observing discrete entities (or traces of these entities), such as $C_{element}$ atoms, and theorizing about how they interact with one another. Documentation of these associations between discrete entities accumulates, which is the basis of another premise of the naturalist philosophy of science: that scientific

[152] Moses and Knutson. 32.

knowledge of the world grows and improves.[153] In order for this view to be tenable, it must be paired with the assumption that the properties of the world itself are stable: e.g., $C_{element}$, then as now, readily bonds with oxygen. In order to discover general laws to explain the workings of the material world, many observations are encompassed in a single theory. Climate models operate according to these basic principles.

The second definition of C_{word} given in the OED recognizes the proliferation of the word's association with climate: "carbon dioxide or other gaseous carbon compounds released into the atmosphere, associated with climate change." The basic outline presented by global climate science tells us that atmospheric concentrations of carbon dioxide are much higher than they would otherwise have been if not for human activities, particularly the invention and vast deployment of many "carbon" intensive technologies since the industrial revolution. Higher concentrations of "carbon" in the atmosphere intensify the "greenhouse effect," in which the radiation of greenhouse gases in the atmosphere warms the earth's surface. Furthermore, the increased quantity of "carbon" in the upper atmosphere remains trapped there for decades, continuing its effect of increasing global average atmospheric temperatures. This effect is more pronounced at the poles, causing melting of the polar ice caps, which in turn leads to sea level rise that threatens to recede coastlines. Some of the "excess" carbon dioxide from human activity also makes its way into the oceans,

[153] Ibid. 30.

causing ocean acidification that affects ocean ecosystems, e.g. by damaging coral reefs.

A number of more localized changes are attributable to $C_{dioxide}$ as well. For instance, because carbon dioxide is food for trees, pollen counts (and hay fever) can increase at sites of dense $C_{dioxide}$ combustion, such as cities. While "carbon" has a fairly *direct* influence in this example, the localized effects of climate change are attributed, *indirectly,* to "carbon" as well. The list of "carbon's" more localized effects, via climate change, is long, including: endangerment of polar bears, shifting species habitats, increases in pine beetle infestation that in turn lead to higher risk of forest fire in the Rocky Mountains, and glacial retreat in the Andes that in turn threatens water supplies.[154] In sum, "carbon" plays a leading role in general summations of anthropogenic climate change.[155] Such an account, however, presents "carbon" removed from the context of its production.

Investigations of the nature and form of this relationship between "carbon" and climate have been underway for well over a century. The ability of carbon dioxide to absorb and emit radiant heat in the atmosphere was first recognized by John Tyndall, an Irish scientist, in the mid-nineteenth century.[156] Nils Eckholm, a Swedish scientist, concluded in 1899 that the rate at which pit coal was being burned

[154] For a compendium of news articles as well as basic information on global warming, see: New York Times, "Global Warming," http://topics.nytimes.com/top/news/science/topics/globalwarming/index.htmloverview
[155] This vignette is rather typical of what has become a genre in its own right: the brief summation of the basics of climate change that are deemed most relevant to non-scientist audiences. These descriptions have become run-of-the-mill in general readership newspapers and magazines, as well as many academic works that discuss the politics of climate change.
[156] James Rodger Fleming, *Historical Perspectives on Climate Change* (Oxford University Press, 2005). 65-74.

could lead to a doubling of atmospheric concentrations of CO_2.[157] A few years later, his good friend, Swedish geochemist, Svante Arrhenius, proposed that carbon dioxide released by burning fossil fuels could alter the planet's climate.[158] Both Eckholm and Arrhenius proposed that increased CO_2 concentrations could cause warming and might be *beneficial* to the earth's climate. For the first half of the twentieth century, however, "most scientists did not believe that increased CO_2 levels would result in global warming."[159]

This consensus broke down in large part in response to the extensive research (from the 1930s until the early 1960s) of Guy Stewart Callendar, an English scientist. In 1938 Callendar developed a model of the climate predicting that a doubling of atmospheric CO_2 would lead to an increase in the mean surface temperature of the earth of two degrees Celsius, although he also noted that carbon dioxide's effect might be "considerably greater than supposed."[160] By 1961, Callendar's body of work arrived at the conclusion that there was a significant trend toward higher temperatures, especially in far-northern latitudes, and that an increase in CO_2 concentrations from the burning of fossil fuels was linked to this trend.[161]

In the late 1950s, Charles Keeling began to track the amount of carbon dioxide present at Mauna Loa, Hawaii, an effort that continues today. These data show a steady increase in carbon dioxide concentrations and are the basis for the

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[157] Ibid. 111.
[158] Ibid: 74-82.
[159] Ibid. 107.
[160] Ibid. 115.
[161] Ibid. 117-118.

aforementioned crossing of the 400ppm atmospheric CO_2 concentration.[162] In the late 1970s an elite group of scientists (primarily physicists), the Jasons, undertook an analysis of carbon dioxide and climate at the request of the US Department of Energy.[163] In keeping with the papers that many professional climate modelers had already published, the Jasons developed a model and concluded that a doubling of atmospheric carbon dioxide concentrations from its preindustrial level, estimated at about 270ppm, would lead to an increase in the average surface temperature of 2.4 degrees Celsius. Although modelers do input other proportions of atmospheric carbon dioxide, investigating what would happen if CO_2 *doubled* has been the convention: carbon dioxide is the primary independent variable in these models. Other variables including "negative feedbacks" that can have a cooling effect, such as clouds and ocean circulation, are factored in as well, but these do not have as much influence as carbon dioxide[164]—the "primary forcing."

During the 1980s a group of scientists actively built the case, through a series of meetings and reports, that institutions to coordinate scientific research and inform policy responses were needed. The UN Intergovernmental Panel on Climate Change (IPCC) was created in 1988 at the suggestion of the World Meteorological Organization (WMO), which saw a need to "impose discipline on the scientific

[162] The Mauna Loa data is the basis of much mainstream climate iconography. So too is the in/famous "hockey-stick" graph, which depicts a spike in average temperatures (based on reconstructed Paleolithic temperature records) since the English Industrial Revolution. The "hockey-stick" featured prominently in a well-publicized documentary, starring Al Gore: Davis Guggenheim, "An Inconvenient Truth," (Participant Media, 2006).
[163] Naomi Oreskes and Erik M Conway, *Merchants of Doubt: How a Handful of Scientists Obscured the Truth on Issues from Tobacco Smoke to Global Warming* (Bloomsbury Publishing USA, 2011). 171.
[164] Ibid. 173.

debate."[165] Since 1990, the IPCC has issued periodic scientific reports of the risks climate change poses to human and natural systems around the world. Early climate science focused on changes to the climate itself, such as predicting the distribution of temperature changes around the globe, with little attention to human systems, political economy, or anticipating adaptations humans might make. In the mid-eighties a community of scholars studying "climate impacts" began to form, gauging the risks climate change posed to natural resources and economies. At first these studies used relatively simple climate models (e.g. holding temperature rises at a constant level of two degrees) and were of limited scope, e.g. focusing on the possible impacts for just a few crops (though with time the models became more comprehensive, e.g. investigating the impact of climate change on food security). The IPCC has become a key referent in political discussions of climate change, sharing the Nobel Peace Prize with Al Gore in 2007.

After publication of the first IPCC report in 1990, negotiations among UN member states regarding an international climate convention got underway. The "Rio agreement" established a goal of stabilizing greenhouse gas emissions at a level that would prevent the dangers of anthropogenic climate change (though it had no binding control measures), and was signed by 154 nations at the UN Conference on Environment and Development in 1992. Since then there have been many other negotiations and attempts, at levels from local to global, and from in and between the public and private sectors, to institute new governance structures that would reduce

[165] Diana M. Liverman, "Conventions of Climate Change: Constructions of Danger and the Dispossesion of the Atmosphere," *Journal of Historical Geography* 35 (2009).

"carbon" emissions.

National and international governmental bodies have been involved not only with *responding* to climate change knowledge, but also with producing it: "Governments have established a host of new scientific advisory processes to produce and validate knowledge related to the activities of the climate regime and to incorporate that knowledge into policy choices." [166] Although the United States has been a leader in the production of climate change knowledge, it has been widely criticized for its failure to lead in this area (e.g. it did not ratify the Kyoto protocol), despite being the world's second largest national emitter (China surpassed US emissions on a national level in 2006, although Americans continued to emit far more than Chinese per capita).[167]

The primary tools for producing knowledge of global climate change are complex computer models (described in more depth in chapter four). According to these models, "carbon" is the crucial variable that determines what future we will get. In order for "carbon" to be understood as the key mechanism of anthropogenic climate change, a scientific consensus that this is the case first needed to develop. This consensus was built through a process of peer review, which is a descendent of the importance of witnessing to the practitioners of seventeenth century experiments. Both are practices that presume to build public trust in science not simply through the

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[166] Clark Miller, "Challenges in the Application of Science to Global Affairs," in *Changing the Atmosphere: Expert Knowledge and Environmental Governance*, ed. Clark Miller and Paul Edwards (MIT Press, 2001). 254.
[167] David Adam, "China's Carbon Emissions Soaring Past the Us," *The Guardian*, June 13 2008.

demonstrative power of observations of nature (be it through experimentation or hypothetical experiments conducted in models of the climate system), but also through associating scientific findings with the trustworthiness of the observers. Scientific consensus regarding "carbon" and climate develops according to the same convention that Boyle proposed, "that matters of fact be established by the aggregation of individuals' *beliefs*" and "[m]embers of an intellectual collective had mutually to assure themselves and others that belief in an empirical experience was warranted."[168]

The IPCC works according to the same principles. Members of the IPCC meet, deliberate and arrive at a consensus, which is encapsulated in a single document.[169] The univocality of the IPCC report thus speaks for science through an expertise that is not corroborated through its proximity to nature alone; the ability of these experts to establish, as a public fact, its basic message – *science says global warming is real and bad*, *therefore "carbon" needs to be mitigated*– is based on their appeal to the authority of decisions made by a process of consensus, and this consensus underpins the authority the report conveys. Expert authority continues to be derived not only from the ability of experts to speak for nature, but on the corroboration of experts with one another. This authority establishes the danger of climate change and the imperative of "carbon" management as facts: the agreement of the majority of climate scientists with one another is a potent piece of political

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[168] Shapin and Schaffer. 25.
[169] The IPCC released its fifth report in 2014: IPCC, "Climate Change 2014 (5th) Synthesis Report Summary for Policymakers." https://www.ipcc.ch/report/ar5/syr/

evidence that underlies claims that climate change deserves a prominent place on the political agenda.

Just as Boyle's "intellectual collective" was made of members holding a shared belief in the ontological metaphor encompassed by Boyle's experimental apparatus, serving on the IPCC is an honor offered only to nominees with the appropriate expertise, and skeptics have complained that they are excluded, *ipso facto*, by virtue of their skepticism.[170] Contention between "skeptics" and "believers" has shaped public discourse about what, if anything, is to be done about climate change, particularly in the US, where media outlets have often followed the "fairness doctrine" of portraying "both sides" of debates, leading climate skeptics to be overrepresented in proportion to their numbers.[171] In other words, consensus—including that which is expressed in the form of the dominant discourse of "carbon"—does not necessarily put an end to political conflict.

Quite to the contrary, the inner workings of the climate science community are now political targets. In the 2009 Climategate scandal,[172] opponents of the climate

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[170] Science and Public Policy Istitute, "Climategate: Caught Green-Handed!," http://scienceandpublicpolicy.org/images/stories/papers/originals/Monckton-Caught%20Green-Handed%20Climategate%20Scandal.pdf.

[171] Maxwell T Boykoff and Jules M Boykoff, "Balance as Bias: Global Warming and the Us Prestige Press," *Global environmental change* 14, no. 2 (2004).

[172] In December of 2009 a series of emails between climate scientists, all linked to the servers at the University of East Anglia in the U.K., was leaked to the press. A few of those emails indicated that some data that did not support climate models had been deliberately suppressed by scientists. One line from one of the hacked emails that has been widely publicized is: "The fact is that we can't account for the lack of warming at the moment and it is a travesty that we can't." The quote is from Kevin Trenberth, a scientist at the National Center for Atmospheric Research (NCAR) and member of the 2007 Intergovernmental Panel on Climate Change that won the Nobel Peace Prize along with Al Gore for publicizing climate change.

consensus hacked into the computers of some prominent climate scientists and published email correspondence that was given as reason to doubt that the consensus was trustworthy. Skeptics may also object that it is important, for the sake of scientific progress, that their unpopular views be included. This argument is in keeping with the premise Kuhn describes in his influential work, *The Structure of Scientific Revolutions*, that not only does scientific consensus determine what science "says," but "scientific progress" occurs when a smaller group of scientists challenges the dominant paradigm to eventually establish a new consensus.[173] Nonetheless, not all dissent is destined to create a new, dominant consensus, and Kuhn's observations remain based on the necessity of consensus for ultimately authorizing scientific truth. Scientific authority continues to rely not only on the ideal of an unbiased representation of nature, but also on the ability of scientists to create *and wield* consensus. The IPCC wields the authority it gains from its consensus, though, this too, is political and carries risks. For example, there is disagreement about whether it is appropriate for the (paid) IPCC chair, as well as IPCC panel members (who are "volunteers"), to receive compensation for acting as consultants who advise organizations about climate change – or if this advice is advocacy that may indicate or encourage biased science.[174]

Although science does not give straightforward answers, "scientific objectivity has come to represent, in Western Democracy, an instrumentally effective force in the

[173] Thomas Kuhn, *The Structure of Scientific Revolutions* (University of Chicago Press, 1962).
[174] Elisabeth Rosenthal, "Skeptics Find Fault with Un Climate Panel," *The New York Times*, February 8 2010.

pursuit of public action, authority, and accountability, buttressing the authority of centralized regulatory institutions."[175] In the program Boyle established, the legitimacy of experimentally produced knowledge was based in a probabilistic view of knowledge, wherein certainty was not total.[176] The lack of absolute certainty of this knowledge was, for Hobbes, grounds for why the experimental method could not be the basis for philosophy and could not produce truth.[177] In climate models, uncertainty is expressed through measures such as "relative error."[178] Although uncertainty is a perennial feature of scientific research, so too is uncertainty a frequent point for science and politics to cross.[179]

Many of the political difficulties in addressing the problem of climate change are connected to an earlier general lack of acceptance that climate change was "real" or a "real danger" –a sentiment that was encouraged by skeptics who highlighted the uncertainty of the models. Any level of scientific uncertainty surrounding the accuracy of climate models could easily be translated into political uncertainty as to the reality of climate change itself. Because there is *always* some level of uncertainty in science, establishing "more" certainty (e.g. smaller relative error) can never close

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[175] Paul N. Edwards and Clark A. Miller, *Changing the Atmosphere: Expert Knowledge and Environmental Governance* (MIT Press, Cambridge MA, 2001). 253.
[176] Shapin and Schaffer. 24.
[177] Ibid. 22.
[178] One climate scientist pointed me toward chapter nine, "Evaluation of Climate Models," in the most recent IPCC report (2014) on "The Physical Science Basis" of climate change, which contains a lengthy discussion of how uncertainty is understood in relation to climate models: http://www.ipcc.ch/pdf/assessment-report/ar5/wg1/WG1AR5_Chapter09_FINAL.pdf
[179] This is by no means unique to climate science – consider the example of the Zadroga bill. Its purpose is to cover medical expenses resulting from exposure at Ground Zero for 9/11 first responders, but it will not cover cancer until there is enough scientific evidence of a link.

the political doorway to doubt that uncertainty can open. Therefore, it would be a mistake for scientists to rely on touting their increasing certainty when their science is also an overtly political matter. As Sarewitz argues, it is unfortunate that the usual response to controversial scientific matters, especially when they relate to the environment, is to request that they be adjudicated by scientific facts; due to the inherently incomplete nature of scientific inquiry, science is likely to inflame, rather than resolve, political disputes.[180]

The Ozone Antecedent

Global warming is neither a separate scientific issue from ozone depletion, nor a separate political issue (despite the distinct problem definitions of the "two" issues). Although the development of an ozone regime to control CFCs is often thought of as a model for the development of a climate regime to control "carbon," the case of ozone can also be characterized as an early episode *within* climate politics.

The ozone layer originated billions of years ago, as a result of oceanic plants releasing oxygen. It is the part of the stratosphere[181] that absorbs much of the ultraviolet radiation that would otherwise reach the earth's surface. Without it, "terrestrial life could not be sustained."[182] Its depletion, well publicized during the

[180]Daniel Sarewitz, "How Science Makes Environmental Controversies Worse," *Environmental science & policy* 7, no. 5 (2004).
[181] Tropospheric (ground) ozone does not rise to the stratosphere, is poisonous, and does not offer the same protective capacity against UV radiation.
[182] Litfin. 54.

1980s,[183] allows more harmful radiation to reach human skin, which increases the risk of developing skin cancer, especially for people with fair complexions (it also potentially interferes with the human immune system). Ozone depletion has other significant effects ecologically: e.g. it can damage plant chlorophyll, retarding growth. Ozone is "continually created and destroyed"[184] through many photochemical interactions. Many new industrial compounds, whose use and applications rapidly expanded from the 1950s to 1980s, were later identified as major ozone depleters: fluorocarbons, which became widely used as refrigerants (especially in automotive air conditioners) and in aerosol propellants, were highlighted.[185] The shorthand CFC (chlorofluorocarbon) would become common parlance, much as would soon be the case for "carbon."

The 1985 Vienna Convention for the Protection of the Ozone Layer was, according to its UNEP sponsor, the first legal instrument for the protection of the global atmosphere (even though it did not mandate CFC reductions).[186] The convention did spur technical and scientific cooperation among the signatories, resulting in much better data-reporting on ozone-depleting substances,[187] which was needed to make reliable scientific estimations of the extent of the ozone problem. It also led to cooperation on better instrument calibration, assisting in better direct

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[183] As Litfin describes, the discursive emphasis on human health effects, as opposed to ecological impacts, is in large part of consequence of Du Pont (the world's largest CFC producer) testifying before the US congress in 1974 that if CFCs came to be found to harm human health the company would stop producing them. Ibid. 64.
[184] Ibid. 54.
[185] Ibid. Chapter 3.
[186] Ibid. 75.
[187] Ibid. 76.

measurement of ozone in the stratosphere, which would help clarify the extent of the problem—estimates of which had varied widely in several decades of research.[188] Despite its lack of teeth, it was significant because it established a general obligation for states not to harm the atmosphere—as opposed to the prior norm of free access to pollute the atmosphere. As Litfin argues, Vienna legitimized the precautionary principle as the political response to the ozone issue. Even though there was not yet direct, observational confirmation of ozone depletion, and there was good but not certain reason to believe that ozone depletion would occur and have negative long-term effects, a norm of non-modification was agreed upon.[189] This precautionary norm would translate into a dominant discourse that was pro-regulatory.[190]

The precautionary and pro-regulatory frame that emerged with the Vienna Protocol would guide further work on the issue and culminate in the Montreal Protocol two years later. By the end of 1989 "the discourse of damage limitation had become universally accepted."[191] Montreal is typically lauded as a monumental agreement that serves as the foundation of an effective global ozone regime, and is frequently referenced as a model for how to approach the climate issue as well. Litfin summarized this phenomenon in 1994, stating "the global ozone regime has been lauded as a prototype for a future climate regime."[192] The standard for "success" in global environmental matters, however, is low: as Litfin notes, "the celebratory mood

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[188] Ibid. 61-73.
[189] Ibid. 76.
[190] Ibid.
[191] Ibid. 139.
[192] Ibid. 191.

that has surrounded the Montreal Protocol and its revisions must be tempered with the recognition that it took thirteen years… to be addressed with concrete action."[193]

It is easy to see parallels in the development of an ozone regime and attempts to develop a climate regime [image 4, pages 90-91]. For instance, an important stepping stone from Vienna to Montreal was a 1986 WMO/NASA report[194]—a general assessment of the state of the knowledge, arrived at through international collaboration, that would become the authoritative basis for negotiations: "the fact that this document represented an international consensus, rather than the work of scientists from any one country or region, was as significant as its actual scientific content."[195] It is not a coincidence that the UN and WMO would create the Intergovernmental Panel on Climate Change, with the similar aim of establishing international consensus on the science of global warming, two years later.

Image 4) Climate "versus" Ozone Knowledge and International Negotiations

Ozone Depletion	**Global Warming**
1985 Vienna Convention • no control measures • legitimizes precautionary approach	1992 Rio Climate Convention • no control measures • legitimizes precautionary norm

[193] Ibid. 197.
[194] World Meteorological Organization, "Atmospheric Ozone 1985," (http://acdb-ext.gsfc.nasa.gov/Documents/O3_Assessments/Docs/WMO_1985/UNEP_WMO_1985_V1.pdf).
[195] Litfin. 80.

Ozone Depletion	**Global Warming**
1986 WMO/NASA report • displays comprehensive consensus of state of knowledge on ozone depletion: "Everyone agreed that [it] represented an international consensus that constituted the scientific basis for ensuing negotiations."[196]	1988 UN and WMO create IPCC • tasked with providing comprehensive reports that synthesize the state of climate knowledge and represent the scientific consensus
1987 Montreal Protocol • establishes controls	1997 Kyoto Protocol • establishes controls
1989 Montreal Treaty goes into effect	1995 Kyoto Treaty goes into effect
1989 UNEP Synthesis Report • summarizes findings of four working groups on the science of ozone • hundreds of scientists involved	1990 First IPCC synthesis report • summarizes findings of three working groups on the science of climate • thousands of scientists involved
Ongoing Many indications of substantial reductions of substances of concern[197]	Ongoing Continued increase in emissions of "carbon"[198]
2016 Indications that the ozone hole is healing[199]	2016 continued expectations of warming trend increasing[200]

The ozone column is listed chronologically, whereas the items in the climate column are paired with their parallel ozone moment. This table is not meant to be comprehensive, as many important developments in these regimes are omitted; rather, its aim is to demonstrate a number of points of similarity and contrast, and their relationship in time.

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[196] Ibid. 84.

[197] Penelope Canan et al., "Introduction to the Special Issue on Ozone Layer Protection and Climate Change: The Extraordinary Experience of Building the Montreal Protocol, Lessons Learned, and Hopes for Future Climate Change Efforts," *Journal of Environmental Studies and Sciences* 5, no. 2 (2015).

[198] P Friedlingstein et al., "Persistent Growth of Co2 Emissions and Implications for Reaching Climate Targets," *Nature Geoscience* 7, no. 10 (2014).

[199] Susan Solomon et al., "Emergence of Healing in the Antarctic Ozone Layer," *Science* 353, no. 6296 (2016).

[200] Friedlingstein et al.

Less often noted than the potential of climate politics to follow the path of Montreal and the ozone regime is the extent to which the climate issue has been intertwined and present with/in the ozone issue. For example, the content of the politically inclusive 1986 NASA/WMO study presented an integrated and technically detailed picture of atmospheric knowledge that described many intricacies and overlaps between the "separate" issues. Image 5 [page 93] is one of countless examples from that publication demonstrating how the issues interrelate.[201]

As the figure illustrates, many of the substances involved in ozone creation and destruction also have atmospheric warming and cooling effects. For example, methane (CH_4) both contributes to global warming and neutralizes much of the stratospheric chlorine that would otherwise deplete tropospheric ozone.[202] The overlap complicated the development of substitutes for CFCs as well. In the late 80s, as proposals to ban CFCs were gaining traction, the US air conditioning and refrigeration industries also faced new energy-efficiency standards, and "[p]otential substitute chemicals and alternative technical designs were likely to conflict with the goal of conserving energy to curb global warming." Non-ozone threatening Hydrofluorocarbons (HFCs) were potential substitutes, but "also potent greenhouse gases."[203]

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[201] World Meteorological Organization. 828.
[202] Litfin. 54-55.
[203] Ibid. 128.

Image 5, reproduced from WMO NASA report, 1986

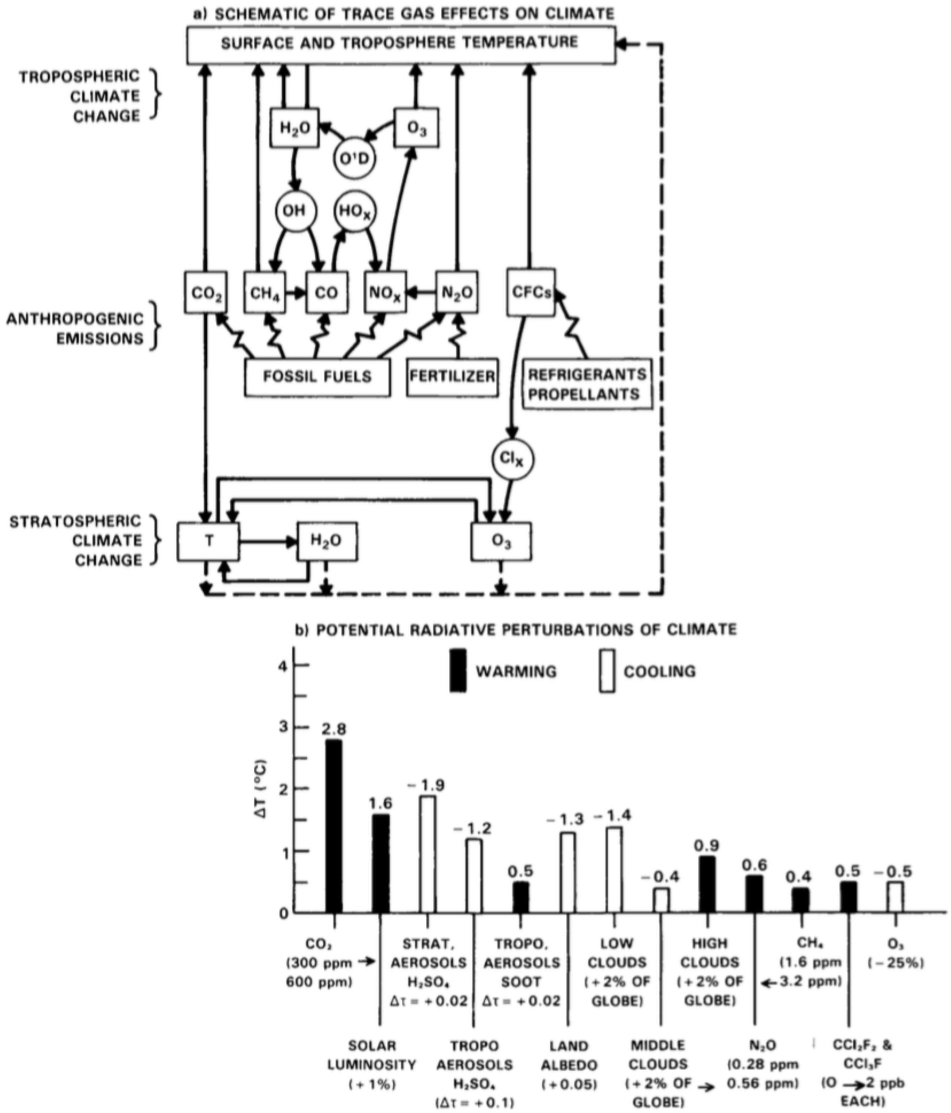

Figure 15-4. (a) Examples of climate effects due to chemically and radiatively active gases (Ramanathan, 1980). (b) One dimensional radiative-convective model estimates of surface temperature effects of various global radiative perturbations. All of the results, except for CH_4, and the figure are adapted from Hansen *et al.*, 1981. The CH_4 result was obtained as follows: The radiative forcing of doubled CH_4 as given in WMO (1982) is multiplied by the climate sensitivity of Hansen *et al.* (1981) model to obtain ΔT_s.

Overlaps in the molecular dynamics of ozone depletion and global warming were consequential during initial attempts to devise climate regulations. For example, the 1991 US Task Force on the Comprehensive Approach to Climate Change, under the first Bush administration, attempted to capitalize on the high GWP of CFCs by proposing to substitute the reductions in CFCs already mandated by Montreal for mandates on fossil fuel emissions reductions.[204] The position that there was "potential folly inherent in relying on increased levels of greenhouse gases to mitigate the impact of CFCs"[205] won out in this instance—bolstered by the finding of a 1991 NASA study that the warming effect of CFCs was offset by the cooling effect of the reduction in ozone (itself a GHG) that they caused—and the Bush administration abandoned its advocacy for the approach in climate negotiations.[206] Although the approach did not succeed in this case, the GWP-based equivalencies of the trading mechanisms established by the Kyoto Protocol in 1997 would support a similarly "comprehensive" approach, counting not merely the "carbon" of fossil fuels, but also other major GHGs, which need not necessarily come from non-fossil fuel based sources. As Litfin describes, "ironically, one of the objectives of the Kyoto Protocol was to avoid mandating CO_2 reductions," so "if carbon discourse became hegemonic, it was in the service of evading carbon."[207]

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[204] Thanks to Karen Litfin for pointing out the significance of the Bush administration's "comprehensive strategy" in the development of CARBON (personal communication).
[205] Litfin. 85.
[206] Ibid. 160-161.
[207] Litfin. Personal communication.

Whereas atmospheric science was presenting an increasingly integrated and holistic picture of ozone/climate—e.g. a scientific conference in 1986 co-sponsored by EPA and UNEP was titled the International Conference on the Health and Environmental Effects of Ozone Modification and Climate Change—the two were discursively framed as separate political issues. Lee Thomas, a former EPA administrator, noted that the combination of the two in the 1986 conference, "had the potential to confuse and compound the political controversy surrounding each issue."[208] Thomas described "the domestic and international politics surrounding each issue [as] separate and unique."[209] Given that "some environmentalists at UNEP and the EPA" perceived that "the ozone issue was nested within the larger and more complex climate issue,"[210] the politics of the two are not as separate and unique as the discursive framing suggests. One EPA staffer, in an interview with Litfin, reported that there were some at the UNEP and EPA who hoped "an agreement on [ozone] could be used as a springboard for dealing with [climate]."[211] Even though "the major scientific studies since 1984 had framed the [ozone] issue substantially in terms of climate," and "scientific discourse and policy discourse diverged"[212] on ozone, this outward divergence was potentially in the service of the larger, longer-term climate

[208] Quoted in Litfin. 89.
[209] Quoted in Litfin. 88.
[210] Litfin. 89.
[211] Loosey in Litfin. 89.
[212] Litfin. 89.

goal: “The issue of ozone depletion, defined narrowly, was perceived as politically manageable, whereas the climate issue was a much greater challenge.”[213]

The Montreal Protocol process “is essentially the story of how a dominant antiregulatory discourse was supplanted by a new regulatory discourse.”[214] Climate discourse is similarly regulatory, and has been for quite some time. Litfin, writing about climate in 1994, stated, “[d]espite the apparent existence of a powerful epistemic community of scientists, environmentalists, and political leaders in favor of regulatory measures, such measures have yet to be adopted.”[215]

“Carbon” signifies and enables the dominant discourse that assumes that climate change can be solved through technocratic management and negotiation—i.e. through various regulatory approaches, especially through the creation and regulation of carbon markets. Some clarification of this point is in order, given that regulatory approaches (e.g. “command and control”) are portrayed as alternatives to or opposites of market based approaches (e.g. “cap and trade”). In the realm of “carbon,” however, this is a distinction without a difference. Carbon markets’ existence is necessarily and profoundly dependent on ongoing regulatory efforts:

> Carbon market requirements for state measurement calculation, monitoring, enforcement, certification, registration, regulation, and creation of property rights (not to mention the constant diplomacy required to keep up confidence that international markets are on track) [are] enormous.[216]

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[213] Ibid. 89.
[214] Ibid. 13.
[215] Ibid. 193.
[216] Lohmann. 98.

The extensive regulatory requirements of “carbon” based “market based” approaches to pollution reduction offer a plausible explanation for the “flip-flop” of the dominant US Republican position on policy approaches to climate change. Whereas many Republican representatives had previously been receptive to (or even promoted) “market based” cap and trade, the party now has overwhelmingly come to characterize such proposals as “cap and tax.” This shift was successfully prompted by Tea Party activists who “detect[ed] unseemly similarities between carbon markets and the dread ‘big government’ approaches of carbon taxes and conventional regulation.”[217] In this atmosphere, cap and trade legislation that the Obama administration pushed hard for in 2010 failed. After the failure of the legislation, many specialized “carbon” funds based in London and Wall Street shut down[218] (offering further corroboration of these markets’ utter dependence on governmental regulation for their existence).

If technocratic/regulatory approaches so far have been, and are likely to continue to be, ineffective (as is argued in chapter two) then using the ozone precedent as a political model for climate is perilous. Although the dominant discourse of climate, CARBON, is regulatory, it has been a political failure. Litfin argues that “knowledge brokers” were instrumental in forwarding the counter-discourse of the precautionary principle that would eventually take over as the dominant discourse in the ozone case. A counter-discourse, in the case of climate,

[217] Ibid. 98.
[218] Ibid. 99.

however, is not likely to emerge from the insider channels that knowledge brokers navigate: the purpose of those channels (e.g. between and within UNEP, IPCC, EPA, WMO) is to develop (or, for some, to quash[219]) regulation. Within those channels, the issue is how, whether, and to what extent to develop systems of regulation (including market regulation) regarding atmospheric controls. In other words, CARBON was made for, and in large part *by,* knowledge brokers who traverse these channels.

Litfin, following Stone, seeks to explain a *policy* outcome through competing *policy* discourses (of non- versus pro- regulation). When regarded as a model for approaching climate politics, this mode of analysis has the teleological effect of focusing on a dependent variable that may have a value of zero: a successful, global "carbon" management regime. Litfin has made the cautious suggestion, in consideration of how the objectives of both the Vienna and Rio conventions were basically the same (i.e. to prevent atmospheric harm, despite both lacking control measures for doing so), that the Rio Convention "may serve the same function for climate as [Vienna] did for the ozone issue: it may establish a discursive norm in favor of precautionary action that may eventually be implemented."[220] Later researchers have been less circumspect, starting from the assumption that the solution to global climate change lies primarily in international negotiations that culminate in

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[219] e.g. When the Reagan administration appointed anti-regulatory administrators at the EPA in an effort to dismantle many environmental regulations and impede the development of more environmental regulations.
[220] Litfin. 194.

a successful climate treaty.[221] The idealization of a teleological model for remedying climate politics is the norm, even when the more challenging nature of the climate problem is acknowledged:

> To an even greater extent than the ozone case, the problem of human-induced climate change dramatically poses the dilemma of formulating policy under conditions of scientific uncertainty when the stakes are very high. The social and environmental damage from global climate change is likely to be far more catastrophic than that caused by ozone depletion, and the perceived costs of regulation are very high. For both issues, the twin problems of accumulation and irreversibility suggest the need for precautionary action before environmental damage is conclusively measured; greenhouse gases, however, are unlikely to precipitate an environmental crisis like the Antarctic ozone hole whose causes can be definitively identified. All of these qualities suggest what experience has borne out: construction of a viable global climate regime will be a formidable task."[222]

In other words, the discursive contours of the politics of ozone have set up the discourse of climate to be preoccupied with the goal of a global regime.

The idealized success of ozone politics has constrained the political vision of climate change activism, prescribing a pro-regulatory goal that has, in discursive terms, already been reached. So long as climate discourse is overwhelmingly oriented toward policy to control "carbon," the response to its failures will continue to emphasize "more policy," rather than "more politics." Climate politics need not be contained by the realm of policy: discourse matters both within and beyond the policy realm. A counter-discourse to CARBON need not be pro-regulatory nor anti-regulatory. Rather, the challenge is to shift the discussion away from

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[221] For example, see: Sarah Manina Kelsey, "The Green Spiral Policy-Industry Feedback and the Success of International Environmental Negotiation," *UC Berkeley Dissertation* (2014).
[222] Litfin. 191-192.

(depoliticizing[223]) policy "fixes" and toward an examination of political dynamics of the problem (a matter that is taken up in chapters three, four, and the conclusion).

Marketization

"The economy" is both important to the historical development of "carbon" and as a corollary to it. "Carbon," like "the economy," did not exist in the past in the familiar manner that it exists in the present. Anthropogenically augmented greenhouse gases were making their way into the atmosphere, and money and goods were circulating within and between nations, but these goings-on were not always understood as "the economy" and "carbon." The new carbon economy is an outgrowth of the rise in attention to these two concepts/things. It is comprised of "several, increasingly inter-connected" and "important but very unstable" carbon markets, strong faith in which, nonetheless, is "a key element of global responses to the threat of climate change."[224]

The notion of *the* economy—an object of calculation—is an important part of the foundation of the new carbon economy. As Mitchell describes, in the 1930s the word "economy" referenced attitudes and relations that followed the principle of attaining a desired end through efficient means. The term "political economy," then, referred to "this economy, or governing, of the polity, not to the politics of an

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[223] See discussion in the introduction to chapter two.
[224] Emily Boyd, Maxwell Boykoff, and Peter Newell, "The "New" Carbon Economy: What's New?," *Antipode* 43, no. 3 (2011). 601-602.

economy."[225] By the 1950s, however, a shift had occurred. "The economy" (something different from "economy" without the definite article) had emerged, denoting "a distinct social sphere"[226] with an inside (the exchange of money and goods, interest rates, etc.) and an outside (culture, government, science, etc.).

"The economy" that came into being post-WWII through Bretton Woods was a defined geographical, *national* (specifically in opposition to and replacing *imperial*) space for the management, measurement, and circulation of money. Decades later, when "carbon" became a concern, notions of responsibility and plans to remediate the climate problem would be laid in large part on the same ground. Responsibility would be apportioned to different states, consequences of remediation would be estimated according to their effects on national economies, and negotiations at the international level that focused on agreeing to different national reduction targets would become perennial fixtures. And, just as the quest for development has been accused of perpetuating imperialism in a different form,[227] "carbon" schemes have been accused of climate colonialism.[228]

The UN Clean Development Mechanism (CDM) is often held up as such an example. Carbon offsets[229] emerged as a "flexible mechanism" of the CDM under the

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[225] Timothy Mitchell, "Fixing the Economy," *Cultural studies* 12, no. 1 (1998). 82.
[226] Ibid.
[227] Henry Veltmeyer, "Development and Globalization as Imperialism," *Canadian Journal of Development Studies / Revue canadienne d'études du développement* 26, no. 1 (2005). 89-106.
[228] Heidi Bachram, "Climate Fraud and Carbon Colonialism: The New Trade in Greenhouse Gases," *Capitalism Nature Socialism* 15, no. 4 (2004). 5-20.
[229] There is also a parallel and as-of-yet mostly unregulated Voluntary Carbon Offset (VCO) market. Credits on the VCO market may be purchased by individuals motivated by a sense of personal responsibility or culpability. Bumpus & Liverman give its contours: Adam G.

Kyoto Protocol, replacing an earlier proposal to create a Climate Development Fund (CDF) that would have facilitated direct transfers of funds and knowledge from developed to developing countries. The rationale for the proposed CDF was to address the asymmetry between developed and developing countries' contributions and vulnerability to climate change; therefore, developing countries "were adamant that any action to deal with climate change be conditional on financial and technical assistance" that would allow them to develop more sustainably.[230] Developed countries and the business lobby were opposed, however, and argued that a CDF was "contrary to the spirit of free market capitalism and the protection of Intellectual Property Rights."[231] In the face of the strong justice argument made by developing countries, the North adopted strategies to "accommodate" the developing countries' position; in negotiations between Brazil and the US, the CDF proposal was changed to the CDM, with the aim of facilitating transfers from North to South, but via market mechanisms.[232] This shift "represented a very successful move by the developed countries to take the sting off the [CDF] proposal and turn it into an accumulation instrument for business and industry actors in the North."[233]

Through the CDM, carbon credits, created through the purchase of carbon offsets, count toward the tabulation of national carbon emissions. The two-fold

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Bumpus and Diana M. Liverman, "Accumulation by Decarbonisation and the Governance of Carbon Offsets," *Economic Geography* 84, no. 2 (2008).
[230] Elah Matt and Chukwumerije Okereke, "A Neo-Gramscian Account of Carbon Markets: The Cases of the European Union Emissions Trading Scheme and the Clean Development Mechanism," in *The Politics of Carbon Markets*, ed. B. Stephan and R. Lane (Hoboken: Taylor and Francis., 2015). 122.
[231] Ibid. 123.
[232] Ibid. 121-124.
[233] Ibid. 124.

purpose of this program is to reduce global GHG emissions and to promote "sustainable development." The rationale underlying carbon offsets is the economic principle of comparative advantage: people in one location offset their own "carbon" emissions through paying to reduce emissions in another place where it is cheaper to do so. In other words, the purchaser is in the "developed" world, and the producer/reducer of the "carbon" is in the "developing" world. This provides a means for industrialized signatory countries to meet their emissions reduction targets even if not all of those reductions are domestic.[234] There is, however, "virtually no evidence that the CDM has resulted in North-South technology transfer, or sustainable development."[235]

In this vein, Liverman suggests that the narrative favoring carbon trading in international climate negotiations is part of a "neoliberal project of market environmentalism" that is unlikely to amount to significant emissions reductions.[236] She estimates that Kyoto's market mechanisms would actually lead to higher global emissions than if only domestic reductions were attempted.[237] Lohmann argues that "Kyoto-style" systems tend to "marginalize non-corporate, non-state and non-expert contributions toward climatic stability."[238] While the UN touts that more than 7000 projects have been registered, and credits for projects for nearly 2 billion tCO_2e have

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[235] Ibid. 125.
[236] Liverman. 280.
[237] Ibid. 295.
[238] Larry Lohmann, "Marketing and Making Carbon Dumps: Commodification, Calculation and Counterfactuals in Climate Change Mitigation," *Science as culture* 14, no. 3 (2005). 204.

been issued,[239] it is clear that these projects do not necessarily translate into development and climate mitigation.

Despite the UN framework that focuses on national emissions tallies and pledges, and the work that states and the UN undertake to establish and manage carbon markets, the practices of “carbon” marketization, especially in the case of offsets, are largely supranational: “carbon finance and information flow across the world to ‘generate’ credits in a network of often small private and non-governmental organizations without reference to national or supranational bodies.”[240] Bumpus and Liverman[241] argue that carbon offsets are a form of climate governance (or at least an attempt therein) that functions via their ability to serve as a capital accumulation strategy, primarily through the market, non-state actors, and supranational channels. In the emergent (much like climate change itself) “carbon” economy, a mishmash of structures, designed to incentivize “carbon” reductions through market-based mechanisms, are put in place around the world. Like “the economy,” the marketization of “carbon” is a concept that creates a framework for calculations to support a certain aim: in the case of the former, it is often development and growth; in the latter, it is typically GHG reductions.[242] In both cases, however, there is potential (or, arguably, an inherent danger) that development projects and “carbon” reduction

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239 UNFCC, "Clean Development Mechanism (CDM)," http://cdm.unfccc.int/index.html. accessed July 23, 2016.
240 Bumpus and Liverman. 15.
241 Ibid.
242 Of course, this juxtaposition fits within the frame of “sustainable development,” itself having drawn criticism, particularly on the grounds that it is an oxymoron: Wolfgang Sachs, "Sustainable Development and the Crisis of Nature: On the Political Anatomy of an Oxymoron," *Living with nature* 23, no. 1 (1999).

projects will exacerbate that which they purport to ameliorate ("underdevelopment" and GHG emissions, respectively). In both cases, it is possible that situations may appear to have improved on paper, but to have gotten worse in "reality." Official practices of representation and measurement can do much more than measure, and often have unintended consequences, as students and educators who have experienced "teaching to the test" are familiar. As carbon markets and credits are built and distributed, "carbon" (as well as climate) is always only indirectly visible through calculations, estimations, proxy measurements, balance sheets and the like. "Carbon" *reductions,* the "real" item of interest, are even more difficult to conjure, as by definition, they are a negative that can *only* exist through calculation. Invisibility is an inherent characteristic of $C_{dioxide}$ that helps explain the affinity between it and balance sheets—through balance sheets "carbon" becomes visible, but those balance sheets need not create an accurate representation of $C_{element}$ in order to represent "carbon."

This aporia is the ground for an infeasible but thought-provoking proposal to make "carbon" visible by adding dyes to the gas.[243] Given the importance of representations of the ozone hole[244] to the development of an ozone regime—because the hole made the problem visible[245]—the lack of a similarly visible manifestation of climate, it has been suggested, is politically unfortunate.[246] Yet, another comparison

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[243] Dawn Stover, "Seeing (Pollution) Is Believing," Bulletin of the Atomic Scientists, http://thebulletin.org/seeing-pollution-believing9181?platform=hootsuite.
[244] The hole is not visible to the naked eye; rather, "a colorful time-lapse videotape assembled by NASA from satellite data dramatically depicted the hole emerging over Antarctica." Litfin. 101.
[245] Litfin. 101.
[246] Litfin. 192.

with the ozone case provides a stronger explanation for the different success/failure of the two issues. In the case of ozone, substitutes for ozone depleting substances could be developed. Furthermore, the ability to profit off of these substitutes was often augmented by forced reductions or bans of the depleting chemicals[247] (as the substitutes were often more expensive).[248] Likely most significantly, the depleting chemicals were contained to a much smaller portion of economic production relative to "carbon."[249]

These factors make it unlikely that the "chicken-and-egg"[250] pattern of regulation and the development of ozone substitutes can be repeated in the case of "carbon." In the case of ozone: "industry questioned the science and claimed that no replacements for the risky chemicals were available, but once the regulations were in place, substitutes quickly came on the market." Therefore, the development of substitutes was generally "contingent on the dominant policy discourse," which "translated into market signals."[251] Regulatory incentives such as rebates for purchasing energy efficient technology, and the basic economic incentives provided at the gas pump and through utility bills, have already promoted the drive to develop more energy efficient/less "carbon" intensive production and consumption *per unit produced.* Efficiency increases, however, do not necessarily translate to net emissions

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[247] Litfin. 155.
[248] Litfin. 125-126.
[249] Litfin describes the cost of controls for ozone as "moderate," and the cost for climate as "very high." 193.
[250] Litfin. 95.
[251] Litfin. 67.

reductions, as greater production may counter-balance efficiency gains. Moreover, developments in “carbon” efficiency are often being integrated *alongside* “carbon” intensive production, rather than substituting for it.[252]

Consequentially, though both problems are primarily concerned with controlling invisible gases, the more limited production chains for ozone depleting chemicals makes them easier to trace and control than the widely dispersed sources of “carbon” emissions. This narrower and more constrained nature of ozone production and distribution means that tracking production and consumption is more feasible, and the results of control measures could quickly be felt. For example, at one point in the development of the Montreal regime, Malaysia complained that “developing countries were not able to obtain adequate supplies of the increasingly scarce and overpriced CFCs.”[253]

Furthermore, the equivalencies between GHGs that are used in carbon trading encourage targeting of the “easier to eliminate” GHGs—HFC-23 and N_2O account for more than half of all the credits issued through the CDM—but these GHGs are “less central to economic growth and generally easier to eliminate than more ubiquitous carbon dioxide pollution”[254] (much like the targeted reductions that have occurred under the ozone regime). In short, while a remedy to the ozone issue could be found largely within the framework of capitalism, the relationship of “carbon” to “the economy” is of a different character. Addressing climate change would amount

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[252] Kenneth Gillingham, David Rapson, and Gernot Wagner, "The Rebound Effect and Energy Efficiency Policy," *Review of Environmental Economics and Policy* 10, no. 1 (2016).
[253] Litfin. 154.
[254] Matt and Okereke. 125.

to more than a minor adjustment of the capitalist world system, as was possible in the ozone case.

"Carbon" and "the economy" work differently in a world that recognizes them as such, versus not at all. When the first industrial revolution was getting underway, $C_{anthropos}$ was ramping up its influence on the atmosphere, but there was not much in the way of a conscious, human acknowledgement that this was the case—"carbon" was profoundly invisible. Correspondingly, the purview of C_{word} did not extend much beyond particular, rather unpolitical realms. Whereas $C_{anthropos/GHG,}$ as it turned out, would become rather important to the future to come after the industrial revolution, at that time the future was not conceived in those terms. By comparison, the future that is imagined now is quite often and explicitly figured to be determined by "carbon" contingencies.

What will be the effect of C_{word} now having this prominent role in envisioning the future, upon the future? Similarly, what might have been different if C_{word} had grown to prominence at a rate that mirrored the growth of C_{GHG} with the industrial revolution? To an extent, these questions grapple with the whiggish problem in a manner similar to how Mitchell notes "the economy" is often projected "onto periods whose politics were not organized around this object."[255] That is, looking back, we can see how "the economy" and "carbon" were both at work before they were described as such. These scenarios get at the question of the difference knowledge *of* the world makes *in* the world. A counterfactual, along the same lines, gets at the issue

[255] Mitchell. "Rule of Experts." 83.

of how knowledge—and language—matters, more bluntly: What difference would it make if we were facing climate change without CARBON?

The US Case

"Carbon" has not always been a guidepost of global environmental politics, though, as seen in various elements of the framework of "carbon" management discussed above (CDM, IPCC, etc.), CARBON is a global discourse. As one colleague who researches United Nations administrative processes told me, when I asked about whether there are ever translation issues with C_{word}, "carbon" is the term that is used at the U.N., and she has never heard an exception or any translation issues.[256] Likewise, a colleague who does fieldwork in China and Taiwan reported that the Chinese word for "carbon" –"tàn" 碳 —translates quite directly and "is used in the same ways" in Chinese as in Anglophone contexts. Likewise, the term for "low carbon" - 低碳 - is used in various contexts; "it's a term in wide circulation."[257] Global, of course, does not mean universal. Another colleague, doing fieldwork in Guatemala, relayed a story of translation issues regarding C_{word}. In this instance, during a presentation to a local community forestry concession regarding REDD (Reducing Emissions from Deforestation and Degradation),[258] a member of the audience (reasonably) interpreted C_{word} to mean "ashes," and proceeded to go on an

[256] Sikkina Jinnah. Personal communication.
[257] Ben Read. Personal communication.
[258] Marleen Buizer, David Humphreys, and Wil de Jong, "Climate Change and Deforestation: The Evolution of an Intersecting Policy Domain," *Environmental Science & Policy* 35 (2014).

“angry rant” about how all the trees should not be burned in order to sell all of the carbon.[259]

While climate change is a global issue, the case of the development of “carbon” politics within the US is particularly noteworthy. The US has often been a conspicuous holdout in global climate negotiations, and has been tasked with “leading by example” as a world super-power, due to its disproportionately large emissions (calculated according to the framework of “the economy” discussed above.) The following, brief history of “carbon” in the US outlines the particular paths that CARBON can follow in a given (e.g. national) context, and is useful for understanding how such particularities are both embedded and influential in the global context.

US environmental politics did not get underway with the preoccupation with “carbon” that is so prominent today. As long ago as the presidency of Lyndon Johnson, who was informed about the basic theory and possibility of human-caused climate change when in office,[260] US Presidents have known about climate change. In a speech to Congress in 1965, in which Johnson made the case for beautifying America, he stated that humans had “altered the composition of the atmosphere on a global scale,” through “a steady increase in carbon dioxide from the burning of fossil fuels,” as well as from “radioactive materials.” This sideways allusion to global warming, which comes halfway through the speech in a subsection focused on pollution, was far from the focal point, however. Johnson presented the “50,000 tons

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[259] Micha Rahder. Personal communication.
[260] Oreskes and Conway. 170.

of unpleasant, and sometimes poisonous, sulfur dioxide" added to the atmosphere in a more threatening light than he did carbon dioxide.[261]

Similarly, "carbon" was not a particularly noteworthy presence when US environmentalism had its political heyday. The monumental environmental legislation that was signed into law by Richard Nixon in the 1970s, such as the National Environmental Policy Act (NEPA) in 1970, and the Clean Water Act (CWA) in 1972, along with his creation of the Environmental Protection Agency (EPA), established the basic environmental regulatory framework that remains in place today. Although climate change was known at the time, the main charge of the new regulatory apparatus was to reduce "pollution," not "carbon."[262] It was worry about other environmental problems, such as the effect of industrial waste on waterways (a problem highlighted when the Cuyahoga River in Cleveland, Ohio caught on fire in 1969), air pollution (such as Los Angeles smog), and the threat of toxic chemicals to human and ecological health (a concern prompted largely by Rachel Carson's best-selling book *Silent Spring,*[263] which focused on the dangers of pesticides*),* not climate change, that were in the political spotlight. The environmental focus of Jimmy Carter's administration was responding to the energy crisis, not climate change. What attention was paid to climate change during the 1980s did not matter much to Ronald Reagan, who launched an assault on the

[261] Lyndon Johnson, "Special Message to the Congress on Conservation and Restoration of Natural Beauty," February 8 1965. http://www.presidency.ucsb.edu/ws/index.php?pid=27285#axzz1Sck07r3O
[262] The two later converge in the argument that "carbon" is a pollutant, discussed below.
[263] Rachel Carson, "Silent Spring. 1962," (1994).

environmental regulatory apparatus that left environmentalists preoccupied with trying to minimize their losses.

By the 1990s, however, climate change had become more visible as an environmental issue, and "carbon" was invoked in some political skirmishes. George H.W. Bush threatened to boycott the UN Earth Summit in 1992 until he was assured that the climate agreement that would come out of that meeting would have no binding targets for carbon dioxide reduction, a move considered an embarrassment to US international environmental diplomacy.[264] Following in his father's footsteps, George W. Bush reversed the decision of his first EPA director, Christine Todd Whitman, to reduce carbon dioxide emissions at coal-fired power plants, a move that was taken as a sign that the EPA would be marginalized by the administration.[265] In between the Bush Presidencies, Bill Clinton did not make noteworthy progress on climate change, despite the devotion of his Vice President, Al Gore, to the issue.

During the George W. Bush, and Obama administrations, "carbon's" place in political discourse has increased dramatically, so much so that it has become difficult to avoid. For example, there have been many iterations of a debate over whether a "cap and trade" program (which sets a cap on "carbon" emissions and allots tradable emissions permits to industrial emitters, establishing market incentives that encourage a net reduction of emissions), or a "carbon tax," would be the most effective manner of reducing "carbon" emissions. Although emissions trading had strong support from

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[264] Norman J. Vig and Michael E. Kraft, *Environmental Policy: New Directions for the Twenty-First Century*, Sixth ed. (2006). 107.
[265] Christopher J. Bosso, *Environment, Inc.: From Grassroots to Beltway*, Studies in Government and Public Policy. (Lawrence: University Press of Kansas, 2005). 3.

Republicans as a "market-based" mechanism—based on the relatively successful regulatory schemes that created a system for emissions trading of sulfur dioxide that reduced acid rain—the party stance shifted, and during the 2010 election many Republicans began referring to cap and trade as "cap and tax."

In 2007 the Supreme Court ruled in a 5-4 decision that the EPA was authorized by the Clean Air Act to regulate greenhouse gases as pollutants, thus bringing "carbon" within the US environmental regulatory framework established in the 1970s (the decision singled out carbon dioxide on several occasions). The decision also instructed the agency that it was required to act in accordance with its best scientific judgment as to whether GHGs caused harmful climate change, not whether they thought that regulation by the US alone would actually make much of a dent in curbing global warming.[266] The Bush administration EPA had argued that regulating "carbon" would not be worthwhile because the link between warming and anthropogenic emissions had not been unequivocally established, so more research was needed. This doubt-mongering approach has proven to be a useful tactic for those wishing to forestall regulation on a number of issues, including acid rain and second hand smoke, in addition to global warming.[267] The Bush administration had also argued that regulation within the US would not stop the large and significant growth of emissions in many developing countries. In 2009 the agency issued its ruling that GHGs did endanger the public, opening the door to regulation. Under this authority, the Obama EPA set stricter vehicle efficiency standards in 2011.

[266] "*Massachusetts V. Epa*, 549 U.S. 497 (2007)."
[267] Oreskes and Conway.

"Carbon," however, is used on the battlefield of US politics more than it could be said to aid in conflict resolution. After the Obama EPA issued a set of regulations to reduce "carbon" emissions from power plants, many states joined a lawsuit challenging the constitutionality of the plan. Although the lawsuit is still working its way through lower courts, the Supreme Court (before Justice Scalia died and left a vacancy that has yet to be filled in the present, divisive climate of Washington politics) put implementation of Obama's clean power plan on hold. (The plan had helped secure the 2015 Paris COP agreement, which has widely been seen as an insufficient but good step toward mitigating "carbon.") Without the clean power plan, the US is not expected to meet its obligations under the Paris agreement. President-elect Donald Trump, days after his election, signaled his intent not to honor the agreement.

"Carbon"

Perhaps the most succinct way to sum up "carbon's" origins is to describe it as, quintessentially, an object of modernity. This section has described where "carbon" came from, in summary, as follows: "Carbon" is a descendent of the naturalist philosophy of science and the authority garnered by its ontological claim to objectivity, which is premised on a particular epistemological framework that draws on experimentation, and social practices of witnessing. Naturalist inquiry looks for patterns in nature, and so the representation of reality that it produces is simpler and less messy than the reality it first observes. In turn, it is assumed that this knowledge can and should be used to "properly" manage society (and nature). Climate science and politics both follow from this way of knowing.

The community of mainstream climate science has taken up the politico-scientific mission of establishing as fact that the warming effect of $C_{anthropos}$ on the global climate gives humans an imperative to manage "carbon." The representationalist[268] ontology that follows from naturalism assumes that humans can fix the world through making adjustments to "carbon," but the reification of CARBON has liberated the signifier from the signified in this case, so that the discourse continues with little regard for what "actually" happens with "carbon." Moreover, the discourse's grounding in scientific consensus only feeds political dissension, which is often expressed through challenges to the "reality" of climate change. The ideal of how "carbon" should come to be regulated internationally is based on (and intertwined) with the model of the ozone regime, but the estrangement of signifier and signified in the case of "carbon" gives reason to doubt that this regulatory ideal will succeed in the case of climate. Another model for managing "carbon," marketization in the new carbon economy, raises serious doubts regarding its ability to commodify this invisible substance, and whether such a process can be undertaken without reinvigorating unequal power relations.

[268] Karen Barad, "Meeting the Universe Halfway: Quantum Physics and the Entanglement of Matter and Meaning," *Duke University Press* (2007).

What is CARBON?

CARBON *a two-part dynamic in which certain underlying assumptions about how the climate changing world works are maintained through outward statements regarding "carbon."*

The modernist foundation of "carbon" accounts for why "carbon" based approaches to climate politics seem so "natural," but also points toward some shortcomings of the CARBON *weltanschauung* that follows from it: as Latour argues, "we have never been modern."[269] Climate change is an affront to the nature/culture distinction upon which modernity rests, while CARBON is the foundation of the approach to the climate problem that treats that dichotomy as real.[270]

CARBON Assumptions

Reductionism and Quantification Reductive (especially quantifiable) strategies pave the path to a solution

"Carbon" evokes the naturalist ontology that the material world is made up of discrete, "real," and identifiable things. $C_{element}$ atoms are an example of such entities, as evidenced by how easily "carbon" is represented numerically. In other words (or numbers), "carbon" can be counted, enabling "carbon" equivalencies and comparisons to be made. The effect of such reduction, however, can be to lose the

[269] Latour. *We Have Never Been Modern.*
[270] The Breakthrough Institute's "Ecomodernist Manifesto" is a brash example of such an approach. For example, they claim that there is a trend toward "significant decoupling of human well-being from environmental impacts" (11), that technology "reduc[es] humanity's dependence on nature" (9), and that development should be decoupled from nature (20): Asafu-Adjaye et al. http://www.ecomodernism.org/.

forest for the trees. For example, Lohmann's critique of carbon markets finds that equating "carbon" reductions from different technologies,

> makes it possible, indeed necessary, to make climatically wrong choices in the name of molecule prices—for example, to use routine, cheap efficiency improvements to delay long-term non-fossil investment, or to build destructive hydroelectric dams that do nothing to displace coal and oil. It also conceals the land-intensive (and thus socially discriminatory) nature of many attempts to 'replace' fossil fuels.[271]

In order for the equivalencies that follow from atomistic or molecular reductionism to make sense, the discrete and real things that make up fossil fuels need to be understood as the same discrete and real things that are present in the atmosphere. "Carbon" makes it possible to conceive of a quite tangible barrel of oil, and the rather intangible atmosphere as, in some sense, the same thing. That is a remarkable feat.

One of the clearest indications that "carbon" has attained dominance in the discourse of global climate governance is that brief allusions to "carbon," in contexts that are not primarily environmental or relating to climate, are made with the obvious intention of conveying a message about the environment or climate. For example, in an article from *Foreign Affairs,* arguing that low rates of economic growth need not necessarily hinder prosperity, there is one brief mention of the environment:

> As technology continues to substitute for labor and synthetic solutions such as industrial composites become more important than raw materials, billions of people will be able to meet more of their basic needs. Although the environmental consequences of a booming global middle class have been severe, the worst may have passed: in 2015, carbon emissions actually fell.[272]

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[271] Lohmann. *The Endless Algebra of Climate Markets.* 108.
[272] Zachary Karabell, "Learning to Love Stagnation: Growth Isn't Everything-Just Ask Japan," *Foreign Affairs* 95, no. 2 (2016). 50.

In other words, "carbon's" primacy in climate discourse has gone so far that it is being deployed to reductively stand in for the state of "the environment" as well.

Agency and Responsibility Agency, hence responsibility, can be attributed through rational calculation

$C_{element}$ bonds are "the same" in fossil fuels, human bodies and geophysics. The corresponding assumption that goes along with reductive "carbon" analyses is that causality lies at an elemental level, and that it does not "matter" where the bonds occur—as particular atoms have bonded elsewhere and will bond in new hosts again. The implication is that, through tracing "carbon," i.e. identifying the points along the chain when and where "carbon" has gotten "out of place,"[273] whom- or what- ever undertook the offending action can be identified. Ergo, the responsible parties can be recognized, and remediation can get underway.

This, of course, is not as easy as it sounds. For example, tracing "carbon" enables the comparison of human actions in different spheres (e.g. economic, environmental and moral) using the same metric, but rather than attributions of agency and responsibility being clarified through this process, "conflicts over the interpretations and definitions of value" result.[274] In this vein, Whittington describes one proposed project, a start-up plan to create a system for credit cards that would automatically factor carbon offsets into purchases, as "technically and ethically

[273] Mary Douglas, *Purity and Danger: An Analysis of Concepts of Pollution and Taboo* (Routledge, 2003).
[274] Dalsgaard. 81.

dubious."[275] Many of the difficulties with "big data" apply here—not even "big data" can record everything. Chapter two illustrates many more difficulties with tracing and attributing responsibility in greater detail.

Energy and Order Energy flows can be reordered on a massive scale without a social reorganization of comparable magnitude

Social revolutions and energy revolutions have, historically, gone hand in hand: "transitions in fuels are inevitably accompanied by widespread social, economic, and political transformations."[276] Paleolithic hunter-gatherers followed the energy; using their mobility, they hunted large animals and gathered plant material. Neolithic settlement-agriculture was based in socio-technologies that allowed for harvest and storage of more solar energy in one place. Today, "organic matter the equivalent of the earth's entire production of plant and animal life for 400 years was required to produce the fossil fuels we burn in a single year."[277] Early industrialization was made possible by an expansion of sources of energy (steam and coal) that could provide more kcal/kg than the by-and-large renewable sources that were relied upon previously.[278] By comparison, in societies that had gone through a Neolithic transition to agriculture, but not a revolution in industrialization, the sources

275 Whitington. 56.
276 Clark A. Miller, Alastair Iles, and Christopher F. Jones, "The Social Dimensions of Energy Transitions," *Science as Culture* 22, no. 2 (2013). 139.
277 Timothy Mitchell, "Carbon Democracy," *Economy and Society* 38, no. 3 (2009). 402.
278 According to Sieferle, the use of non-renewable sources such as coal were not unheard of prior to 1800, but were rather limited to areas in close proximity to where deposits were readily available, and applied to particular heat intensive trades like the burning of limestone or metal-smithing: Rolf Peter Sieferle, *The Subterranean Forest: Energy Systems and the Industrial Revolution* (White Horse Press, 2001). 78.

of energy for the production of goods were overwhelmingly plant based, and constrained by the annual cycle of plant growth.[279]

Energy systems are socio-technical systems that include: "financial networks, workforces and the schools necessary to train them, institutions for trading in energy, roads, regulatory commissions, land-use rules, city neighborhoods, and companies as well as social norms and values that assure their proper functioning."[280] The massive breadth and scale of the current configuration of energy systems means that they have a foundational role in the current world order:

> Energy systems are among the largest human enterprises, comprising 9 of the 12 most heavily capitalized companies in the world. They form the heart of the technological arrangements around which contemporary industrial economies are organized. Efforts to transform energy systems involve changes, therefore, not only to energy technologies and prices but also to the broader social and economic assemblages that are built around energy production and consumption.[281]

Therefore, energy transitions are not merely energy transitions. Rather, they are "about who benefits and who is put at risk… the power of regulatory institutions, the structure of markets, and the distribution of wealth."[282]

CARBON discourse, however, conveys the message that the unfolding energy transition should reductively focus on alternative energy sources that emit less "carbon," as if social configurations merely follow from energy configurations. Renewables have "widely been linked in the popular imagination to a more just social

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[279] E.A. Wrigley, *Energy and the English Industrial Revolution* (New York: Cambridge University Press, 2010).
[280] Miller, Iles, and Jones. 136.
[281] Ibid. 135.
[282] Ibid. 140.

order," but this result is "not inevitable."[283] The form of energy does not determine the form of the system that follows.[284] How energy is utilized, how it is distributed, and how much demand for it is cultivated, are consequential questions that seem to easily be overlooked with a myopic focus on "carbon," while the relative "carbon" intensity of different sources of energy is spotlighted instead.

Awareness that human actions on a large scale have atmospheric consequences is spurring conscious efforts to transform energy systems.[285] Approaches to the transformation of energy infrastructures, however, typically focus on energy systems as a precursor to social change—as in the case of ecomodernism illustrated below—or largely in isolation from the social dimensions of these socio-technical systems. For example, Miller et al critique major reports by the US Department of Energy and the US National Academy of Engineering, "the most comprehensive analyses of the US energy policy in the past decade," for "reduc[ing] energy systems to remarkably narrow configurations of energy technologies, the prices at which these technologies can deliver energy in a useful form, and the carbon emissions they release."[286]

Similarly, ecomodernism assumes that better social outcomes will follow from the decarbonization/intensification of energy sources. Ecological modernization is of particular note because it has come to dominate climate politics, reframing the

[283] Ibid. 144.
[284] Ibid. 139.
[285] Ibid. 137.
[286] Ibid. 135.

climate problem "as an opportunity to construct a new carbon economy." [287] In its preoccupation with decarbonization, ecomodernism prioritizes efficiency and quantity simultaneously—i.e. the more energy the better, and the less "carbon" per unit of energy the better. This orientation follows from teleological, modernist assumptions: that economic growth is the pathway toward better standards of living; that humans and nature can and should be "liberated" from one another; and that this liberation will be achieved through technological innovations that produce more units of energy with lower and lower—and eventually zero—"carbon" emissions per unit of energy produced.

Ecomodernism can be traced to the dubious assumption that the intensification of energy leads overwhelmingly to positive and liberatory social developments (and that negative consequences can be remedied by further ecological modernization). For example, the *Ecomodernist Manifesto* states, "any conflict between climate mitigation and the continuing development process through which billions of people around the world are achieving modern living standards will continue to be resolved" in favor of development.[288] Therefore, they argue, there is no "*quantified* climate mitigation scenario in which technological change is not responsible for the vast majority of emissions cuts" [emphasis added].[289] Nowhere do they suggest that dynamics outside of energy, such as the proliferating cultivation of individual identity around consumption (which promotes increasing consumption around the world) is

[287] Ian Bailey, Andy Gouldson, and Peter Newell, "Ecological Modernisation and the Governance of Carbon: A Critical Analysis," *Antipode* 43, no. 3 (2011). 683.
[288] Asafu-Adjaye, J., et al. 21.
[289] Asafu-Adjaye, J., et al. 22.

worth exploring as a response to environmental problems. Nor do they explore how not all phenomena that develop with modernization are positive—the "obesity epidemic" is one of many downsides that can be argued to result as well.

Now that a socio-technical system has been established to harvest and distribute fossil fuel energy, changing that order in a way that would "keep it in the ground" will not take place without significant transformation of this network, which includes much more than the raw fuels themselves (e.g. expectations of automobility, norms surrounding consumption, oil companies, pipelines, fossil-fueled war-making machines, etc.). New, "greener" technological changes are underway, e.g. electric vehicles (EVs), home solar panels, and ride-sharing companies like Uber and Lyft, but these are largely working within or making small changes to the existing system, not threatening its fossil-fuel basis.[290] Such proposals miss the potential of "carbon" to do much more than mere representation, but for CARBON to become a powerful force in the world:

> [Carbon's objectification] encourages northern consumers to consider part of their emissions to be simply "unavoidable" rather than as part of a pattern of energy use that can only be tackled through political and social organizing. It conceptualizes global warming primarily through complex calculations of guilt over individual "carbon footprints" rather than, for example, the study of international oil politics or the history of social movements that have achieved structural change of the magnitude required to alleviate global warming.[291]

CARBON is the product of the modern order, and likely to do more to hold it up than to dismantle it.

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[290] David Biello, *If the Fuel Source Ain't Clean, Your Electric Car Ain't Green*, podcast audio, Scientific American2014, https://www.scientificamerican.com/podcast/episode/coal-powered-electric-cars-pollute/.
[291] Dalsgaard. 88.

Knowledge and Mastery	Solutions follow logically and easily from knowledge, which humans are progressively mastering

"Carbon's" aforementioned quantifiability means that measurements of it can be included in statistical analyses. Statistics falls just below experimentation in the hierarchy of scientific methods because it shares the same basic premises of naturalist philosophy.[292] Mathematical techniques can be used in statistical analysis to "control" data when the control offered by experimentation is not available in practice. The statistical method systematically applies inductive reasoning to data in a search for patterns. When patterns are found, they can become an argument for reordering society (etymologically, "statistics" is a reference to information about the *state,*[293] again demonstrating the relationship between knowledge and social order).[294] For instance, the relationship that has been found between the amount of "carbon" in the atmosphere and the mean global temperature is the basis for attempting to reduce "carbon" emissions.

Climate science sends the message that "carbon" is the mechanism and measure of climate change to be disseminated to the world of politics. Ironically, CARBON's appeal to activists and policy makers is, in a sense, that it gives the appearance of being apolitical—a mere representation. That representation, however, also comes with an inherently political imperative to reorder society's "carbon" practices. As described in *The Economist*:

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[292] Moses and Knutson. 70.
[293] Ibid.
[294] Like experimentation, before this method of knowledge production came to be considered legitimate, it had to gain favor through a social process and was met with resistance: Ibid: 73.

> Left to themselves, carbon-dioxide levels in the atmosphere are expected to remain high for 1,000 years—more, if emissions continue to go up through this century. It is increasingly common to hear climate scientists arguing that this means things should not be left to themselves.[295]

Scientists may attempt to tell society what to do, but they cannot make politics follow these recommendations. (And, even in the case of seemingly clear messages from science, such as CARBON, within science there is plenty of disagreement about many of the finer details). In short, if we are to enact the science/politics binary with regard to climate change, it is a political problem much more so than a scientific one.

Conclusion

"Carbon" has come to seem to be a natural part of climate discourse; the reasons are presumed to be obvious—"carbon" becomes the clear answer to a straight-forward math or engineering problem. This attitude is a testament to the dominance of CARBON in climate discourse. CARBON should work (i.e. be an effective tool to "fix" climate change) in modernity's framework: it is terribly, logically appealing. However, it is also through our naturalist, inductive training that we can see that CARBON does not work as assumed. Ironically, therefore, modernity's epistemological guidance with regard to climate change, leads to challenging the guiding assumptions of modernity itself. CARBON is a manifestation of the now widely accepted conceptual division between social and natural order that organized life into the "separate" spheres of science and politics. As this chapter has

[295] "The Anthropocene: A Man-Made World (Science Is Recognizing Humans as a Geological Force to Be Reckoned with)," *The Economist*, May 26, 2011.

shown, “carbon” is not an ahistorical “fact”; it has a long and complex history that continues to matter today. The consequence is that the discourse of CARBON promotes the assumption that “carbon” will act in the world in a modernist vein, which makes it more difficult to grapple with climate change’s challenge to a (post) modern world.

Carbon Chains

Carbon Dating

In 2015 I attended a gathering of extended family to celebrate those who had recently had birthdays. Another party-goer, (the genealogy is complicated and beside the point, so I will call him) my cousin, arrived alone, without his girlfriend, as we had grown to expect. When some of us inquired about her whereabouts, he informed us that they had recently broken up. We were surprised, as they had moved in together several months beforehand, and had gone on vacation together only a month earlier. When we asked him what had happened, he was not able to offer much by way of an explanation, but his mother, my "aunt" (who already knew about the breakup) was happy to step in and offer her interpretation. She began by bellowing, with great incredulity, "she [the ex-girlfriend] doesn't believe in climate change!" My aunt elaborated that the young woman was from a conservative family, and the ex's mother had discouraged her from studying education because it is a liberal profession (the young woman had, nonetheless, gone on to become an elementary school teacher). She went on, saying that the now ex-girlfriend had said that she did not believe "carbon emissions from humans" caused global warming: "can you believe that she is teaching children?"

The subtext was clear. By proclaiming that the ex was a climate denier, my aunt asserted that the relationship was not meant to be. This difference was a synecdoche of a larger problem of identity, and "us" versus "them." The many well-matched attributes of the couple—they had played the same sports, enjoyed many of the same activities, had mutual friends, had come from professional families with similarly high incomes—were obscuring their fundamental difference and mismatch. Caring about "carbon" was a marker of "which side you're on," and they were not on the same side. Had the couple stayed together, ended up getting married and having children, how could they possibly be raised with such fundamentally conflicting systems of values?

The ability to explain a breakup in terms of the different feelings of two people with regard to "carbon" is, from one angle, an ordinary instance of a family encouraging a "proper" match. Yet, it is noteworthy that the carbon footprints of these two families were on par with one another. C_{word} conveyed identity, regardless of the similar C_{GHG} impact of the families. The "liberal" family also displays its concern with a hybrid SUV and an "energy-efficient" (and large) house. (They keep the thermostat and hot tub at low settings when they're away from their vacation home, but, obviously, two homes contribute more to climate change than one). The act of communicating identity, however, does not necessarily translate into a net positive effect for the climate[296]: e.g. in climate terms, the energy efficiency of the family's primary residence must be weighed against frequent air travel (the young man and woman flew to visit one another regularly for many months when they were living several hundred miles apart, and the family regularly takes international

[296] This sort of calculation, of course, is operating according to the admittedly flawed, neoliberal framework that prioritizes individualized accounting of responsibility.

vacations). Nonetheless, C_{word} emerged when it was time to explain a difference in culture and identity—such discussions were not had when the couple was emitting large quantities of $C_{dioxide}$ to maintain the relationship.

This wing of the family is full of political people. They keep up to date on current events, and vote. Politics is a common conversation at the dinner table, as are group family emails on political topics, such as standardized testing, issues of inclusivity in Silicon Valley, or housing competition in San Francisco. Most of them are involved in their communities in one way or another through fundraisers, membership in political organizations, or attending political protests. The depoliticized aura of climate change, however, means the "political" activity on the climate issue comes in the form of the occasional mention of support for high-level action on climate change, but generally it is easy to know where they stand through less direct expressions of caring about the issue—serving local foods or giving boutique green gifts for holidays and birthdays. They are not naïve, and do not expect these practices to actually contribute to fixing climate change—this engagement, like that of explaining a breakup with reference to C_{word}, is an exercise in declaring allegiance to one's in-group[297] more than it can be called climate action.

This familial anecdote is one perfectly ordinary instance of how the depoliticization of climate change unfolds in practice. "Ordinary people" tend to expect the issue to "really" be handled higher-up. The potency of climate change and

[297] Generally speaking, in-group determines where one stands on climate change, not the other way around: Dan M. Kahan, Hank Jenkins-Smith, and Donald Braman, "Cultural Cognition of Scientific Consensus," *Journal of Risk Research* (2010).

“carbon” in everyday evocations of identity rests on one side of the depoliticized coin—the other side being the technocratic domain of “carbon” management. The ironic consequence of “carbon’s” depoliticized role in this scenario is that “carbon” conveys *concern* with regard to $C_{anthropos,}$ regardless of whether that concern translates into an appreciable difference in $C_{anthropos}$ by those who express the concern. In other words, CARBON is based on a representational assumption, but, in this example, it has the opposite effect, alienating C_{word} and “carbon” from one another.

Chapter Argument and Organization

This chapter’s argument, put succinctly, is that C_{GHG} is resistant to the control that CARBON seeks. This chapter illustrates the commonality of efforts to control “carbon” that are superficially aimed at a material goal (“carbon” reductions), but primarily work in and on the “social” world. In many instances, these efforts to control “carbon” replicate familiar patterns of privilege, power and inequality, while their climate impact is dubious. In other words, the material aims of CARBON are easily subordinated to the social arena, while CARBON’s impact upon “nature” is not as intended. Given this in/consequentiality in nature/social relations, “carbon” does not seem to follow the dictates of CARBON.

This asynchrony belongs with the riddle of ecological paradox: “the curious simultaneity of an unprecedented recognition of the urgency of radical ecological policy change, on the one hand, and an equally unprecedented unwillingness and inability to perform such change, on the other."[298] Blühdorn[299] casts the disappointment surrounding the COP 15 Copenhagen negotiations as a moment of recognition of the ecological paradox of contemporary ecopolitics. CARBON is both a synecdoche of this phenomenon, and a contributor to it. Through CARBON, a lot of conscious effort is channeled toward "the climate," but this does not amount to much of climatic consequence.

Instead of enabling humanity to intentionally, collectively and *effect*ively address the problem, CARBON seems to ineffectively address the problem. The discourse promotes and normalizes *efforts and displays* of care and action on climate change, but these do not seem to readily translate into significant "carbon" reductions. Given the technical aura surrounding "carbon," caring about climate change is understood to mean caring about "carbon" based political solutions, particularly an international agreement on binding national reductions, relegating the "real" work of climate remediation to be "left to the experts."

In other words, CARBON risks insulating climate change from politicization and encourages "depoliticization." As Swyngedouw[300] describes, the depoliticization of climate change takes the form of a discourse of "tecnhno-managerial-eco-consensus" that maintains "we have to change radically, but within the contours of

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298 Ingolfur Blühdorn, "The Politics of Unsustainability: Cop15, Post-Ecologism, and the Ecological Paradox," *Organization & Environment* (2011). 3.
299 Ibid.
300 Erik Swyngedouw, "Depoliticized Environments: The End of Nature, Climate Change and the Post-Political Condition," *Royal Institute of Philosophy Supplements* 69 (2011).

the existing state of the situation… so that nothing really has to change!"[301] The "existing state of the situation," according to Swyngedouw, is a liberal-capitalist order that lies beyond dispute, and the radical change that is called for is the mitigation of "carbon." The "techno-managerial-eco-consensus" refers to the largely institutional and technocratic approach to climate governance, e.g. as expressed in the annual meetings of the Conference of Parties to the Kyoto Protocol, at which experts and negotiators discuss the possibility of binding emissions reductions, and settle for targets that everyone agrees are inadequate. The depoliticization of climate change feeds the aforementioned ecological paradox, and CARBON is tightly woven between.

The role of "carbon" in the depoliticization of climate derives, in part, from the resounding consensus surrounding the discourse of "climate stabilization," i.e. the idea that stabilization of the earth's climate, via the reduction of CO2 emissions, is imperative. As Boykoff et al.[302] argue, however, stabilization targets are politically infeasible relics of realms of expertise such as ecological economics, policymaking and climate science that are likely, in practice, to impede more meaningful climate policymaking. The myopic discourse of climate stabilization encourages a reductive view of the climate problem as one of "carbon reduction" –a project in which anyone can voluntarily enroll (especially for the sake of profit), but that depends on agreeing

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[301] Ibid. 264.
[302] Maxwell T. Boykoff, David Frame, and Samuel Randalls, "Discursive Stability Meets Climate Instability: A Critical Exploration of the Concept of 'Climate Stabilization' in Contemporary Climate Policy," *Global Environmental Change* 20, no. 1 (2010).

to compulsory reductions arranged through compromise at the international level, which few expect.[303] The result of the climate stabilization discourse is not the compulsory reductions that are the object of its perpetual teleological desire, but a situation of carbon compulsion.[304] Following this compulsion, the obsessive desire for "carbon" reduction is manifested in a plethora of practices in which we continually strive and fail to achieve our CARBON fix.[305]

The opening story of "carbon dating" is one example of many vignettes that this chapter offers with the aim of illustrating why the human efforts that have given rise to CARBON have not led, on balance, to significant reductions in $C_{anthropos.}$ My aunt's mention of "carbon" was an expression of her sentiments regarding what kind of person would be an appropriate match for her children—my cousin's sister was in the room for this conversation, and it is a safe bet that she and her boyfriend would have had a heavy conversation ahead of them if he was a climate denier too. This talk of "carbon," however, coexists with the much higher than average carbon footprints of the un/concerned parties. Ironically, CARBON seems to enable this discordance. The family that makes radical lifestyle choices and "sacrifices" by composting everything or radically cutting its carbon footprint is the exception that proves the rule: one does not need to be a green practitioner in any serious way in order to be

[303] The 2015 Paris COP resulted in an agreement that has, arguably, lowered the bar of this goal even further, with signatories making voluntary pledges, rather than being held to mandatory limits. Given the anarchic structure of international politics, there is arguably little difference between the two. Institutionalist international relations scholars could reasonably characterize either scenario as an instance of cooperation, and Realists can reasonably point out that defections are feasible in either case.
[304] The resemblance to obsessive-compulsive disorder is not accidental.
[305] Chapter three examines the ideological/psychological/agential dimensions of this compulsion.

"on the right side"—it suffices to profess belief in the science and support for (perpetually unrealized) political efforts to "cut carbon."

The dissertation's introduction, "Climate Conundrum," gave a brief overview of the morass of climate politics and established the premise that the key to understanding this problem is "carbon's" centrality to the discourse of climate change. Within this discourse, efforts to tackle climate change are, overwhelmingly, reduced to the control of "carbon." This chapter illustrates how controlling "carbon," an abundant and invisible element that is the stuff of life itself, turns out to be a much more challenging task than carbon reduction(ist) proponents ever seem to realize. Indeed, controlling "carbon" is as insurmountable an endeavor as efforts to manage human politics, and the two are deeply intertwined as well.

The bulk of this chapter is devoted to providing several illustrations of the ironic in/effectiveness of CARBON in human and human-atmospheric relations. The approach undertakes a close examination of "carbon" in an attempt to provide a rich or thick description of what it does in the world. Whereas the previous chapter presented a longer view, filling in some historical layers and philosophical dimensions of how CARBON came to be, this chapter focuses on "the present." This analysis is presented as ethnography, though not in the traditional sense of an analysis based on the experience of a researcher's lengthy stay in one particular place. Rather, this "multi-sited ethnography" uses the technique of "object-tracking."[306] This method is well adapted to global phenomena like climate change because it allows a

[306] Marcus.

view of linkages between different parts of a dispersed phenomenon, through the tracking of a common-object—in this instance, "carbon." This collection of "carbon" moments is gathered from a variety of sources, including scholarly literature and personal observations. The following chronicles what could be thought of as "a day in the life" of "carbon" (though the particular events recorded here actually take place over a longer stretch of time).

The themes that emerge from this ethnographic survey, for the purposes of form and narrative, are categorized under headings that start with "c." These particular words were chosen because they encapsulate the diversity of sites and functions of CARBON. It is also a nod to the convenience of "carbon" as an organizing device in climate politics; in a sense, this artful organizational form is a reenactment of the reductionism of CARBON. These sub-headings mark the jump to a different site, in addition to being descriptive of the content therein. The people, places, and practices contained within are diverse, but taken together they demonstrate how CARBON is integral to the ecological paradox and depoliticization of climate change.

In this collection of "carbon" happenings—calculations, commodifications, conscriptions, etc.—it is evident that much is done in the name of "carbon," ostensibly for the sake of the climate, but that these happenings are more consequential for the humans involved than for the climate. Moreover, these "carbon" activities, on the whole, work with the same principles of the world that created anthropogenic climate change, rather than against them. In short, "carbon" does a lot in the world, but *what* it does does not do much to alter the trajectory of climate change.

Contrition

In the summer of 2007, Pope Benedict XVI arranged for the Vatican to purchase carbon credits from a private company, KlimaFa, to offset the Vatican's carbon footprint. KlimaFa was to plant a "Vatican Forrest" that would keep more "carbon" on earth and out of the atmosphere. Many commentators likened this purchase to the former practice by the Roman Catholic Church of selling indulgences, which would basically offset (to use a contemporary analogy) the purchasers' sins and get them more quickly to heaven. The purchase of carbon offsets is similarly a way to cleanse away contemporary "sin" –using electricity, driving a car, or flying in a plane that is powered by fossil fuels. KlimaFa, however, never planted any trees and is now itself defunct.[307] There are no empirical tests available to know what impression the purchase made upon God, if any.[308]

Since that time, Pope Francis has articulated a new position for The Church with regard to carbon credits, perhaps informed by his predecessor's foray. (In tandem with the release of the encyclical, Francis planted a tree himself.) In his lengthy 2015 encyclical on the environment, Francis states:

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[307] Doug Struck, "Carbon Offsets: How a Vatican Forest Failed to Reduce Global Warming," *The Christiain Science Monitor*, April 20 2010. http://www.csmonitor.com/Environment/2010/0420/Carbon-offsets-How-a-Vatican-forest-failed-to-reduce-global-warming

[308] Likewise, it is not known whether purchasers of indulgences were successful in buying their way into heaven.

> The strategy of buying and selling "carbon credits" can lead to a new form of speculation which would not help reduce the emission of polluting gases worldwide. This system seems to provide a quick and easy solution under the guise of a certain commitment to the environment, but in no way does it allow for the radical change which present circumstances require. Rather, it may simply become a ploy which permits maintaining the excessive consumption of some countries and sectors.[309]

News coverage of the eco-encyclical overwhelmingly characterized it as making the case that climate change is a serious problem, downplaying its pervasive critique of systemic bases of inequality and injustice, especially through markets. For example, the Washington Post described the encyclical as an "argument for a new partnership between science and religion to combat human-driven climate change,"[310] emphasizing its scientific details at length, but making only brief and indirect allusions to markets, never mentioning the word directly.

Commoditization

The most obvious and overarching manner in which "carbon" has been enlisted into the project of depoliticizing climate change is its self-evident primacy in "the new carbon economy." This "historically unparalleled experiment in marketized

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[309] Pope Francis, "Encyclical Letter *Laudato Si'* of the Holy Father Francis on Care for Our Common Home," news release, 2015, http://w2.vatican.va/content/dam/francesco/pdf/encyclicals/documents/papa-francesco_20150524_enciclica-laudato-si_en.pdf. 126.

[310] Anthony Faiola, Michelle Boorstein, and Chris Mooney, "Release of Encyclical Reveals Pope's Deep Dive into Climate Science," *The Washington Post*, June 18 2015. https://www.washingtonpost.com/local/how-pope-franciss-not-yet-official-document-on-climate-change-is-already-stirring-controversy/2015/06/17/ef4d46be-14fe-11e5-9518-f9e0a8959f32_story.html

environmental governance"[311] is comprised of a number of loosely connected forays into market-based projects to control "carbon."

The most noteworthy of these projects, and the one most foundational to the establishment of the new carbon economy, is the Clean Development Mechanism (CDM), which was created under the UN's Kyoto Protocol. The CDM allows for the creation of carbon credits (called Certified Emissions Reductions, or CERs, under the CDM), which one entity (e.g. an EU member or private corporation) can purchase from another. The rationale for this arrangement is that of efficiency and flexibility. These transfers are deemed to be the most cost-effective means to reduce emissions, as capital moves from more to less developed countries, where it is thought to be more cost-effective to develop new emissions-reduction projects.[312] In order for a CER to be issued, a project must demonstrate "additionality"—that more greenhouse gasses would be emitted without the project than with it—an always conjectural abstraction that causes one of many difficulties for the legitimacy of carbon markets (as further elaborated below).

Varieties of market-based schemes have followed in the CDM's footsteps, using a number of different units of "carbon" (constructed through equivalency with the Global Warming Potential or GWP of one tonne of carbon dioxide)[313]: The New Zealand system uses NZUs (New Zealand Units); the European Union's ETS uses EUAs (European Unit Allowance); the unit under the Kyoto Protocol is the CER

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[311] Boyd, Boykoff, and Newell. 604.
[312] A longer discussion of the CDM is given on pages 45-48 of the previous chapter.
[313] A longer discussion of GWP is given on pages 12-14 of the previous chapter.

(Certified Emission Reduction); Australia's Carbon Pollution Reduction Scheme uses (AEUs); one of several voluntary markets (the aforementioned are all "compliance" based) uses VERs (Voluntary Emissions Rights). Most other systems simply refer to their units as "allowances," "carbon permits," etc. The list goes on and the trend is toward proliferation. These intricate programs are deliberated, designed, and orchestrated by experts and elites. As the proliferation of acronyms indicates, they are technical creations of elite eco-managerialism.

Proliferation should not, however, be taken to indicate effectiveness. In economic terms, carbon markets have been disappointing. The largest scheme, the EU ETS, saw a crash of carbon prices in 2013. The World Bank, which has been influential in the establishment of carbon markets, has stopped publishing its annual report on the *State and Trends of the Carbon Market*, which estimated market volume. Instead, it now issues a publication that maps carbon prices—not volume, which would be "a seemingly clear advertisement of the apparent failure of carbon markets" because the removal of "over-allocated" permits from the market has been used as a strategy to stabilize prices.[314]

The markets are also ineffective in ecological terms. For example, The EU ETS "has not incentivized investment away from fossil fuels even in the one sector, electricity generation, that has been consistently short of emissions rights.[315] After the

[314] Benjamin Stephan and Richard Lane, "Zombie Markets or Zombie Analyses?," in *The Politics of Carbon Markets*, ed. Benjamin Stephan and Richard Lane (Hoboken: Taylor and Francis, 2014). 2.
[315] Lohmann, "The Endless Algebra of Climate Markets." 107.

EU introduced the ETS, EU CO_2 emissions increased.[316] In ecological terms, many "carbon" projects have also been counter-productive (though profitable). One review found that every project abating HFC-23 and SF_6 in Russia, under the Kyoto Protocol's Joint Implementation mechanism, "increased waste gas generation to unprecedented levels once they could generate credits from producing more waste gas." The high GWP of these molecules, combined with low abatement costs, created "perverse incentives to increase production or generation of waste gases as a means to increase credit revenues from waste gas abatement."[317] Chinese factories have also profited from carbon credits for destroying HFC-23, even though it was the byproduct of HCFC-22, another greenhouse gas: "This industry could produce HCFC-22 that was cheaper than a carbon credit was worth on the market."[318] A colleague provides another example from her fieldwork in Guatemala. She attended a "ceremony to celebrate a carbon-fixation tree planting project… financed by a big Guatemalan 'socially responsible business' association." The project "involved cutting lines through naturally-regenerating forest, already about 2-3m high, in order to plant little foot-tall tree seedlings every 5x10m."[319]

Many experts work from the assumption that emissions trading is the most efficient means to cut GHG emissions, and that command-and-control regulation is

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[316] Clive L. Spash, "The Brave New World of Carbon Trading," *New Political Economy* 15, no. 2 (2010). 171.
[317] Lambert Schneider and Anja Kollmuss, "Perverse Effects of Carbon Markets on Hfc-23 and Sf6 Abatement Projects in Russia," *Nature Climate Change* 5, no. 12 (2015). 1061.
[318] Dalsgaard.
[319] Personal communication with Micha Rahder, August 20, 2011.

inefficient, a narrative[320] that has achieved the status of "fact" in many circles.[321] These arguments in favor of marketized "carbon," however, rest largely on deductive logic rather than inductively gathered observation. The pervasive presence of numbers in this milieu, however, presents an empirical guise that is easily taken as evidence that marketized approaches are "objectively" the best course of action. As Lane[322] demonstrates, this frame of competition between market and regulatory approaches to pollution management is the product of a series of events and re-articulations of the meaning of "the environment" and "the economy," and their relationship to "growth" and one another. It was not until the mid-1970s that "the environment" was conceptualized in a manner that harmonized with economic theory, "with pollution reconstructed as an externality driven by inadequate pricing,"[323] and within the frame of "the economy" as having an imperative and limitless potential for growth.

Critiques of carbon markets extend beyond their disappointing performance (according to market criteria) to their depoliticizing effects. For example, Stephan and Lane[324] note that the presumptive joint economic and ecological effectiveness of the "efficiency" of carbon markets displaces debates about fossil fuel dependence with "technocratic discussions about the design details of emission trading systems or

[320] For an enactment of this narrative, see: C2ES Center for Climate and Energy Solutions, "Cap and Trade," in *Climate Change 101* (Pew Center on Global Climate Change, 2011). http://www.c2es.org/docUploads/climate101-captrade.pdf

[321] Richard Lane, "Resources for the Future, Resources for Growth: The Making of the 1975 Growth Ban," in *Stephan, B. And R. Lane (2014). The Politics of Carbon Markets. Hoboken, Taylor and Francis.* (2015).

[322] Ibid.

[323] Ibid. 46.

[324] Stephan and Lane.

offset mechanisms.[325] Matt and Okereke[326] critique carbon markets on the grounds that they are potentially counterproductive, saying marketized carbon has "been very successful in creating a sense of climate proactivity by government and industries" that may serve the function of protecting them from pressure to do more.[327] Despite their apparent ineffectiveness, all indications[328] are that carbon markets will continue to march on—this irony has led them to be called carbon market "zombies" (an offshoot of the notion of "zombie neoliberalism").[329] "[A]bout 20 percent" of the World Bank Group's funding is "climate related," and projected to increase to 28 percent in 2020.[330]

Radical Environmental groups that focus on "climate justice," have apparently had little success in challenging the marketization of "ecological services" in their quest for the "de-economicization"[331] of climate politics. This effort at repoliticization has not stopped the market-zombies. As mentioned in the dissertation's introduction, a potential tack, which may be more likely to move

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325 Ibid. 11.
326 Matt and Okereke.
327 Ibid.125.
328 For example, the World Bank finds that "Global Cooperation through Carbon Markets Could Cut Climate Mitigation Costs Dramatically: World Bank, "State and Trends of Carbon Pricing 2016," (Washington DC2016). http://www.worldbank.org/en/news/press-release/2016/10/18/global-cooperation-through-carbon-markets-could-cut-climate-mitigation-costs-dramatically-new-world-bank-report
329 Reyes, O. (2011). "Zombie carbon and sectoral market mechanisms." Capitalism Nature Socialism **22**(4): 117-135. See also, Stephan, B. and R. Lane (2015). Zombie Markets or Zombie Analyses? In *The Politics of Carbon Markets*. Hoboken, Taylor and Francis.
330 World Bank, "Climate Finance Overview," http://www.worldbank.org/en/topic/climatefinance/overview#1.
331 Blok. 465. As Blok notes, the term has been used by Latour, relatedly, to discuss the "limits of economization as a model for constructing the good common world," in: Bruno Latour, *Politics of Nature: How to Bring the Sciences into Democracy* (Cambridge, Mass.: Harvard University Press, 2004).

beyond the environmental activist fringe and into the mainstream, could focus on "carbon" rather than markets. Given the unimpressive track record of market-based approaches to climate mitigation, environmentalists should consider this alternative conceptualization of "decarbonization." That is, their goals may be better served by decarbonizing environmental activism (as opposed to the word's usual usage, referring to efforts to decarbonize an economy).

Credit

In 2013, the President of the University of California, Janet Napolitano, created a UC-wide "carbon neutrality" initiative.[332] The initiative is a commitment to "net zero" C_{GHG} from UC buildings and vehicle fleets by 2025. According to the Sustainability Programs Manager at UCSC, what is actually done and what this "carbon neutrality" means is created by ongoing committee work. She reports that the running joke among the administrators at the meetings is that if they do not figure how to "go carbon neutral," they will go and buy a bunch of carbon offsets on December 31st, just in time to meet the deadline.[333] Carbon offsets can be purchased after they have been rendered into commodity form as carbon credits.

Carbon markets require the creation of carbon credits—a process that takes quite a bit of work. This work can encourage curious estrangement from climate

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[332] Office of the President, "Carbon Neutrality Initiative," University of California, http://www.ucop.edu/initiatives/carbon-neutrality-initiative.html.
[333] Erickson, E. Panelist, "It's About Time: how perceptions of time influence environmental action," Meeting of the Science and Justice Working Group, University of California Santa Cruz. October 7, 2015.

change, with greater consequences for the human workers involved. Lansing's[334] in-depth investigation, tracking the work involved in the maintenance of a single carbon offset created by a foreign[335] company for the voluntary market (e.g. selling offsets on the internet to private consumers wishing to offset the climate impacts of driving or flying) in Costa Rica, provides an illustration.

The offset was based in the creation of a conservation area, off-limits to agriculture or development, based on the idea of sequestering "carbon" in the plant life of the area. The creation of the area is not a one-time occurrence, however, as "the offset is in constant danger of becoming undone" from clandestine tree removal, illicit planting of crops, the break-out of a fire, or de-legitimization if the purchasers of the offset suspect fraud.[336] As such, maintenance takes place through an annual gathering of representatives of the company, local indigenous political leaders, government bureaucrats, NGO members (including eco-tourists), and academic observers. They meet to take an inventory of the space, maintain its conservation status (e.g. through posting signs prohibiting extractive uses at its boundaries), and document that it is being protected in a report.

The central task of the "carbon verification trip" is the measurement of the Cartesian space of the reserve, not the direct measurement of "carbon." In response to the distribution of maps of the space by the NGO leader, Lansing wonders:

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[334] David M Lansing, "Performing Carbon's Materiality: The Production of Carbon Offsets and the Framing of Exchange," *Environment and Planning-Part A* 44, no. 1 (2012). 204.
[335] Lansing does not specify the nationality of the company, in the interest of respecting informants' anonymity.
[336] Ibid. 205.

> why did he pass around maps? If we were there to verify a carbon offset project, why were we not examining tables, charts, and graphs that demonstrate the levels of carbon being fixed? After all, that is what was being sold: carbon that is being fixed in the ground.[337]

The answer is that the idea that this forest sequesters X amount of "carbon" had already been stabilized as a fact[338] (or at least is treated as a fact in this setting, though it faces destabilization from other areas, as this chapter demonstrates), but the space of the forest had not been similarly stabilized.[339] It is clear that the project matters for the humans involved: through this conservation project a number of people have taken a trip to the reserve; some landowners have been paid for their agreement to let the land alone; government bureaucrats certify the reserve and sell the credit as part of their job; the scientists on the trip may gather information that they use to write papers and further their careers; consumers may go online and purchase a credit, assuaging their guilt on the carbon market that this reserve is a product of and also helps to maintain; one of these landowners "may use his carbon payment to purchase a forest elsewhere so his son may clear it."[340] This last item points to the possibility that the maintenance of this offset/preserve does not necessarily have the desired net "carbon" impact. It also illustrates that the enormity and complexity of the socio-natural interactions involved in the creation of offsets means that their precisely quantified results belie the

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[337] Ibid. 209.
[338] Bruno Latour and Steve Woolgar, "Laboratory Life: The Construction of Scientific Facts," *Princeton University Press* (1986 (1979 1st ed.)).
[339] Lansing. 209.
[340] Ibid. 210.

underlying flux that makes "carbon" sequestration on a scale that matters inherently unrepresentable by a degree of accuracy that is convincing.

The work of establishing the reserve is largely performative, and the script of this performance has political implications, respecting certain forms of agency—and therefore different actors, over others. Consider what happens when the group comes across a field of plantains. Members of the government consult their GPS devices and determine that the field is inside the reserve, and therefore illegal. The indigenous president of the local community organization, pointing to a tree and a river, says he knows the border lies between them, and therefore the plantains are outside the reserve. The president is outnumbered and overruled by those wielding GPSs, and he agrees to cut down the plantains, at his expense.[341] Lansing describes the disempowerment of the indigenous president as the result of how his entreaty was illegible and laid outside the legitimate techniques (GPS locating) for drawing up a report:

> the kind of space that [the president's gesture] conjures was untenable within the context of our group's performance. Without the measuring devices that contextualized his body's actions within a globally defined, abstract, Cartesian space, his actions had no meaning… The president's performance of space, as it occurred alongside those with their GPS devices, served to reinforce the global, absolute space as the norm that was *necessary* for this commodity to come into being (emphasis in original).[342]

This remains true even though the leader of the NGO later realized that he had made a mistake, having loaded the wrong projection into the GPS device; the

[341] Ibid. 211.
[342] Ibid. 212.

indigenous president's assertion of the boundary was deemed to be correct only after the group's GPS maps read the space as outside the boundary.

Many other ethnographic accounts document negative effects from "carbon" projects for communities in developing countries, and frequently these projects are part of the CDM.[343] The moniker "climate colonialism," through pointing toward a system of oppressive relations with older roots, communicates how the new carbon economy functions through imbalanced power relations that are not exactly new. It also suggests that the new carbon economy is doing more to maintain the dominant world order that precipitated climate change than it is to challenge it.

This example of the maintenance of one carbon offset proceeds, ironically, through bracketing climate change and "carbon." After the "carbon" value of the forest has been established, practices and performances unfold for the most part without it; "carbon" functions largely in the background. In other words, "carbon" is in one sense obviously central to these interactions, but it is also oddly peripheral. This is similar to the role "carbon" often plays in climate change science. In both, "carbon" may be largely relegated to a black box. From its various boxes, "carbon" becomes institutionalized: the livelihoods of many people are tied to this project, and this effect is multiplied by all the similar projects in the greater context of the new carbon economy. Yet, the effect of this project for the climate, like that of carbon markets writ large, is disconnected from the "reality" of climate change.

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[343] A collection is given by: Steffen Böhm and Siddhartha Dabhi, "Upsetting the Offset," *The political economy of carbon markets, Mayflybooks, London* (2008).

Counting

Accounting has a vernacular association with insipidity; the lackluster field's influence with regard to climate politics is due, in part, to the perception that it is boring. Accounting is profoundly technical; therefore, it easily aligns with and reinforces the depoliticized atmosphere of climate change. The large body of academic literature on accounting and society, however, has firmly established that accounting practices are not mere representations of economic transactions and the like, but that the practices of accounting shape and are shaped by their broader social context. The accounting profession, as shown by Lovell and MacKenzie,[344] has created a place for itself within (and contributed to the formation of) the techno-managerial apparatus that governs climate change. It has done this through the application of standard accounting techniques to "carbon."

The techniques that are used, however, vary (e.g. how liabilities and assets are balanced or whether they are measured at cost or market value). There have been major, as yet unsuccessful, efforts by international accounting organizations to create a set of uniform international standards. For example, the International Accounting Standards Board's International Financial Reporting Interpretations Committee, in the lead up to the launch of the EU ETS, made recommendations for how to incorporate the scheme's carbon trading units, EUAs, into the financial accounts of corporations. Their recommendations were withdrawn after they sparked controversy amongst some of the entities regulated under the scheme. This conflict is a reflection of how

[344] Heather Lovell and Donald MacKenzie, "Accounting for Carbon: The Role of Accounting Professional Organisations in Governing Climate Change," *Antipode* 43, no. 3 (2011).

different accounting practices matter to different interests involved (e.g. an electric utility versus a producer of industrial goods). Accounting for "carbon" proceeds through a range of standard but not standardized practices, leaving room for accountants to record a corporation's "carbon" finances in more than one way—likely choosing the schema that is most economically beneficial to the company's bottom line.

Lovell and MacKenzie also demonstrate, in their study of professional accountancy organizations, that the accounting profession has constructed climate change as a corporate problem—especially in that financial reporting is a primary means for firms to report on what they do. For example, they show that accountancy has responded to climate change by framing the problem as solvable via existing accounting techniques—which, of course, require the skills and expertise of accountants. This engagement with climate change, however, is similar to how accountancy approaches other problems: "the new carbon economy represents business as usual" for accountants.[345] To enable business as usual, however, the profession has evolved from what was an ad hoc response to climate change in the early 2000s, to an increasingly "strategic engagement," with policy communities since 2005. In short, accountancy continues to be accountancy, but can now do so "in what is a new policy 'space' for accountants generated by climate change."[346]

Accountants are only one piece of the larger assemblage of the new carbon economy, and they deal with "carbon" primarily through numbers on a page or a

[345] Ibid. 725.
[346] Ibid. 725.

screen. Accountants then take this abstract and reduced "carbon" to produce balance sheets, at which point firms can translate these balances into "action on climate change." Especially in light of the financial crisis of 2008, and the revelation of the accounting "tricks" (e.g. the bundling of sub-prime mortgages) that helped lead to a bubble that burst, there are plentiful reasons to take the claims of these balance sheets *vis a vis* climate change with a grain of salt.

Conversion

The mathematical and quantified realm of "carbon" equivalencies belies the stratified social structures in which such conversions are applied. A campaign by a regional Danish bus company, Midttrafik, to "become a world savior" through choosing alternative transportation, is one example. To make its case, Midttrafik engages in a number of "carbon" based conversions between different activities. For example, they state that choosing a bus over a car is the equivalent of saving the CO2 emitted by frying X pieces of toast, or brewing X cups of coffee (depending on the distance traveled). However, this frame fails to differentiate between "actively choosing the bus and being forced to choose the bus."[347] That is, the campaign is an appeal to people who do not need the bus in order to travel, and it appeals to them by arguing that they may opt to take the bus as a moral statement.

The same message is put even more bluntly on a button distributed, for free, by a local climate action organization in Santa Cruz California [image 6, page 151].

[347] Dalsgaard, S. (2013). "The commensurability of carbon: Making value and money of climate change." HAU: Journal of Ethnographic Theory **3**(1). 88.

The button, obviously intended to be worn as a display of one's moral-ecological pride, reads simply "I bus by choice." A basket of these buttons, free-for-the-taking, were available to the (by-all-appearances economically comfortable) attendees of an event, "Climate Change: The Moral Dimension," held at a United Church of Christ in Santa Cruz, California in February of 2016. At the welcome table, where attendees could sign in and get a program, they could also get a sticker. The sticker features a gold star, framed by the phrase "Reducing Carbon & Congestion." [image 7, page 152]. In the middle of the star are three options from which attendees could check—and thus advertise—how they arrived: either by walking, bike or bus (though it should be noted that the parking lot was fuller than the bike racks).

Image 6) "I Bus By Choice" button

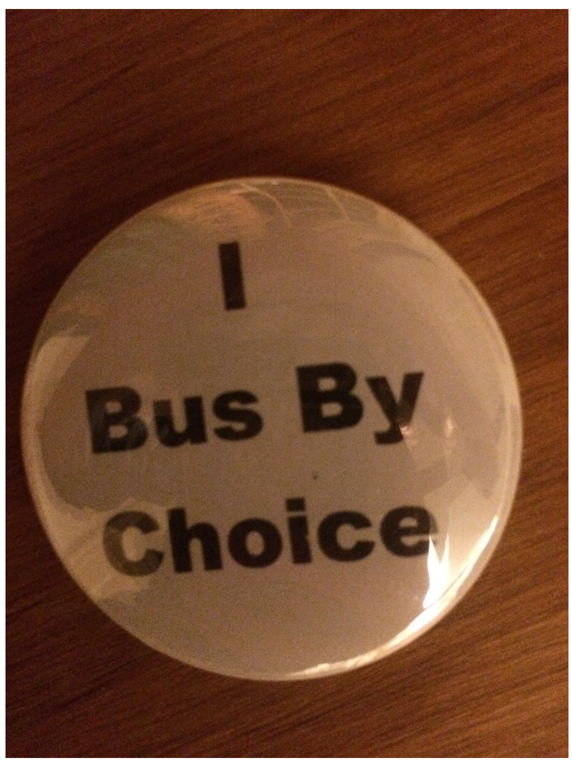

Image 7) “Reducing Carbon & Congestion” Stickers

The moral value of these “carbon” conversions results from the ability to choose a “low carbon” *option.* Ironically, although calculations via individual carbon footprints find that it is by-and-large more wealthy and western individuals who have higher carbon footprints, the privileging and privileged frame of choice enables the ability of higher “carbon” emitting consumers to make moral statements through “carbon,” while those who are “low-carbon” out of necessity are not cast in the same virtuous light. The “I bus by choice” button differentiates its wearer from the bus-riding homeless person or low-income rider whose car broke down. While “carbon” makes it possible to calculate all of their identical bus rides as numerically equivalent, this equivalence also glosses over the discursive work that CARBON does in perpetuating familiar hierarchies of class and race.

Contraposition

CARBON's contribution to the quagmire of climate politics is perhaps nowhere more obvious than in the rhetoric of US national, partisan politics. The parties have largely taken different positions and assigned different meanings to "carbon." For example, the 2016 Republican Party Platform opposes "any" carbon tax,[348] and states the party will "forbid" the EPA from regulating carbon dioxide.[349] The 2016 Democratic Party Platform declares the party "will take bold steps to slash carbon pollution."[350] CARBON does not seem to have done anything to calm this pronounced dynamic of doubt versus belief in U.S. climate politics; the consensus of mainstream climate scientists is frequently juxtaposed with the judgment of climate "skeptics" and "deniers." The disproportionate representation of the skeptic camp in the media[351] further helps to polarize U.S. public discourse on the topic and create an atmosphere of "debate."

At one pole is senator James Inhofe (Republican), who has called global

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348 Republican National Convention, "Republican Platform 2016," https://prod-static-ngop-pbl.s3.amazonaws.com/media/documents/DRAFT_12_FINAL[1]-ben_1468872234.pdf. 20.
349 Ibid. 21.
350 Democratic Platform Committee, "2016 Democratic Party Platform," https://www.demconvention.com/wp-content/uploads/2016/07/Democratic-Party-Platform-7.21.16-no-lines.pdf 27.
351 Boykoff and Boykoff.

warming "the greatest hoax ever perpetrated on the American people."[352] At the other pole is former senator and vice-president Al Gore (Democrat), who has opined that "we should not wait, we cannot wait, we must not wait" to address the threat of global warming.[353] This dramatic language and the gulf between these positions is politically consequential. In 2010, Republicans, many of whom actively touted their disbelief of climate science in their campaigns, took back the House in a landslide. Republican Congressman Bob Inglis, who lost his party's nomination in the primary, blamed his loss on the "heresy" (in the eyes of fellow Republicans) that he had committed by crossing over to "Satan's side" and publicly stating his belief in the reality of climate change.[354]

Incidentally, Inglis believes that he will be vindicated, eventually, when history confirms the science once and for all.[355] In other words, it is the climate itself, not the workings of partisan politics in a democracy, that Inglis identifies as having agency here. (The relevance of this tangent to "carbon" and environmental activism is illuminated in the next chapter.)

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[352] James M. Inhofe, "Senate Floor Statement," January 4 2005. http://inhofe.senate.gov/pressreleases/climateupdate.htm

[353] Al Gore, "On Katrina, Global Warming," in *National Sierra Club Convention* (San Francisco2005). September 9, 2005. http://www.commondreams.org/views05/0912-32.htm

[354] Evan Lehmann, "Republicans Learn the Perils of Being Politically Incorrect on Climate Change," *The New York Times*, November 22 2010. http://www.nytimes.com/cwire/2010/11/22/22climatewire-republicans-learn-the-perils-of-being-politic-3326.html?pagewanted=1

[355] Science Friday, "Americans and Climate Change," (radio broadcast, December 3 2010).

Calculator

Carbon calculators typically include reflexive components to encourage behavior change. The UK government sponsored carbon calculator, "Act on CO2," provides users with a benchmark for comparing their average annual CO_2 tonnage, which is determined by comparing the user's annual emissions (e.g. 4 tonnes) with the average annual emissions that were calculated for other users "who have similar circumstances in terms of house type and size; heating type; and number of people in the home."[356] In other words, the calculator is attempting to encourage people to be more efficient with regard to their circumstances, not to question the ecological implications of those circumstances themselves. The message is: "use less energy in the home you have," rather than "consider the ecological implications of the home you have."

The more troubling notion that carbon calculators may convey, however, is the assumption that calculation is a necessary and crucial step toward fixing the climate problem. In an academic comparison of carbon calculators, Padgett et al demonstrate a great deal of inconsistency between online carbon footprint calculators, and argue that standardization is needed. They write that the variations in calculator outputs "*could* influence both the types of steps individuals take (e.g., focus on household electricity use versus transportation) and the overall level of effort (e.g., the total amount of emissions reductions achieved or offsets purchased)," and "*could*

[356] Sally Eden, "Making Carbon Calculations Work," in *Governing the Climate: New Approaches to Power, Rationality and Politics*, ed. Johannes Striple and Harriet Bulkeley (New York: Cambridge University Press, 2014).122.

affect the extent and focus of public pressure on policymakers regarding emissions reduction efforts directed at house-hold and personal transportation emissions" [emphasis added]. Needless to say, it is an extremely rare individual who regularly consults carbon calculators before making decisions and uses those calculations to significantly influence which course of action they choose. The authors' paltry justification for why standardization is an important goal is hypothetical and unsubstantiated; it also exemplifies the extent to which the dominant discourse of CARBON promotes the faulty assumption of a straightforward relationship between "carbon" and its representations.

Yet, starting from the assumption that calculations "could" guide individual actions and "could" have an aggregate influence on public policy formation, Padgett et al incongruously seem to suggest that the representative accuracy of carbon calculators is relatively unimportant, as "[t]he variability observed here does not necessarily imply invalid results."[357] In other words, two different carbon footprints for the same individual can both be "correct" –a tacit acknowledgment that accurate attributions of "carbon" to individuals are not possible. Another academic analysis of carbon calculators makes a related point, more directly. Eden notes that "the socioeconomic conversion of money to carbon is itself a complex assemblage that shifts in and out of accuracy with the changing market"[358] –e.g., the calculator converts the input of pounds spent on heating oil and converts it to the amount of "carbon" that would be calculated based on the price of heating oil from two years

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[357] Padgett et al. 113.
[358] Eden. 119.

prior, which has changed significantly. Therefore, "although the online results seem fresh each time, the carbon calculator is always historical"[359] and "time itself is poorly accommodated in the calculators."[360] Eden also describes the interactions of her students with the calculators, who often did not readily have the information calculators requested (e.g. electricity bills, knowledge of building materials, etc.), and so would "resist, guess, estimate, and fudge to speed calculation up."[361] These are only the beginning of the endless string of challenges to accurate "carbon" attribution.

The elusiveness of "accurate" ascriptions of "carbon" prompts the question of whether attempts to improve such calculations are likely to ever succeed to a sufficient degree. If not, CARBON can be expected to continually prompt appeals for such improvements in measurement. Such calls perpetuate CARBON discourse more than climate remediation. A close reading of the calculator comparison by Padgett et al. illustrates the tenuousness of the logic that such calculations are of climatic import:

> The discrepancies in output do have *potential* effects, however. A difference of several tons in an individual's calculation of personal emissions *may* induce different responses. For example, if a carbon calculator gives a lower value for air travel and a higher value for vehicle use, an individual *may* be induced to opt for air travel more often. Similarly, if an individual's overall carbon footprint from a specific calculator is higher, the individual *may* put a greater effort into a range of reductions or offset purchases or both. These variations also *may* influence the extent to which citizens and policymakers support different types of individual reduction measures. [emphasis added][362]

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359 Ibid.119.
360 Ibid. 120.
361 Ibid.118
362 Padgett et al. 113.

In other words, what matters is the reaction that the carbon footprint inspires in the individual. There is little reason to expect human actions to be significantly guided by carbon footprints, however, as this chapter's opening anecdote is but one illustration.

Conspiracy

The aforementioned inaccuracies of carbon calculators, considered in the aggregate context of the scale of the quantity of molecules and calculatory apparatuses involved, prompts further skepticism with regard to the effectiveness of CARBON. Padgett et al., in an ironic attempt to illustrate that uniformity between carbon calculators is a worthwhile project, state:

> Using year 2000 values, if 1% of the U.S. population had inaccurately estimated their emissions by 2 tons (1.8 metric tons) per person per annum, this would result in a value for CO2 emissions that was approximately 5.6 million tons (5.1 million metric tons) too high or low. [363]

That is, the project of merely assigning responsibility for "carbon" emissions is overwhelming, and challenges to the accuracy and meaning of such determinations are to be expected. The difficulties of "carbon" metrology, however, go far beyond estimation errors and the temporal trickiness of proxy measurement.

The now infamous Volkswagen "defeat device" provides an illustration. In 2014 when researchers from West Virginia University were testing cars from a number of manufacturers under road conditions, they found that the levels of Nitrous Oxides emitted by Volkswagen diesels were drastically higher than U.S. EPA limits,

[363] Ibid. 113.

and higher than tests conducted under customary, laboratory testing conditions. This investigation led to others, leading to Volkswagen's admission that it had been programming its diesels to perform differently in test mode.[364] In test mode, engine performance decreased, bringing emissions within legal limits. In regular driving mode, however, the engine performed well—and emissions were up to forty times U.S. legal limits.[365] By the time the deception came widely to light, the computer code (i.e. "defeat device") had already been installed in new Volkswagens from 2008 to 2015.

During that time, Volkswagen aggressively advertised its "green" diesels to a niche market of ecologically-concerned and relatively affluent consumers in the U.S., who were willing to pay a premium for the diesels based on their eco-credentials (diesels are rare and more expensive relative to gasoline engines in the U.S., compared with Europe).[366] With the revelation of the deception, there have been furious reactions from these customers. Around half-a-million of these "clean diesels" were put on the road in the U.S., and more than ten-million worldwide.[367]

This is only the tip of the iceberg. The defeat device is only one form of Volkswagen's efforts to avoid reducing its products' emissions:

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[364] Jon Linkov, "Volkswagen Emissions Cheat Exploited 'Test Mode': The Common Mode Enables Dyno Testing, but Vw Used It to Game the System," *Consumer Reports*2015. http://www.consumerreports.org/cro/cars/volkswagen-emissions-cheat-exploited-test-mode
[365] Due to strict U.S. laws in this area, and particularly the Clean Air Act, Volkswagen faces enormous fines and is liable for compensating owners in the US. In Europe, however, Volkswagen's actions are not so clearly legal violations, though their reputation among Europeans has been severely tarnished nonetheless.
[366] Geoffrey Smith and Roger Parloff, "Hoaxwagen," *Fortune*, March 7 2016. http://fortune.com/inside-volkswagen-emissions-scandal/
[367] Ibid.

> VW has a legacy as a quasi-state entity that has long steamrolled regulators [in Germany]. The company and the auto industry are so crucial to Germany that Chancellor Angela Merkel has repeatedly intervened to stave off or weaken emission regulations.[368]

Furthermore, the complications of regulating and tracking "carbon"[369] are hardly limited to Volkswagen. Emissions Analytics, A U.K. consulting company, has tested hundreds of non-Volkswagen diesel models under real-world driving conditions, finding that only about one percent "actually met the standard they are licensed to."[370] Emissions are often determined to have been underestimated after-the-fact. After the Volkswagen scandal came to light, Mitsubishi admitted to having improperly conducted fuel-economy tests for more than two decades. The Volkswagen revelation has also spurred further inquiry: "independent tests showed that across the board, official NO_X figures in Europe were a far cry from expectations."[371]

Volkswagen is not the only cause for major revisions of emissions data that was proclaimed in 2015. In the same year, the Chinese government published revised statistics for its coal use from 2000 to 2013, in order to compensate for previous data collection gaps from small factories and companies. The revision means that estimates of Chinese "carbon" emissions have been underestimated by a billion-or-so tons in recent years. The director of a Chinese University based Energy Economics Research program reported to the *New York Times* that the revision has:

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[368] Ibid.
[369] The substances underestimated because of the defeat device were GHGs, though their health impact closer to ground level is arguably the bigger concern in this case.
[370] Smith and Parloff.
[371] "Exhaustive Analysis: The Gulf between Test Results and the Real World Widens," *The Economist*, April 30 2016. http://www.economist.com/news/business/21697869-gulf-between-test-results-and-real-world-widens-exhaustive-analysis

> created a lot of bewilderment… Our basic data will have to be adjusted, and the international agencies will also have to adjust their databases. This is troublesome because many forecasts and commitments were based on the previous data.[372]

Once again, "carbon" evades the control that CARBON seeks.

Of course, there is no guarantee that inaccurate emissions will be recalculated and corrected, or that corrected estimates will lead to more effective efforts to track and/or restrain emissions. Not long after the Volkswagen scandal had broken, I took my (Toyota) car in for its biannual smog test, as required by the state of California. While one of the mechanics did the inspection (she later reported that it passed), I spoke with another mechanic about the scandal. He stated that after-market modifications causing effects equivalent to defeat devices were common. Indeed:

> Petrolheads worldwide purchase and then erase or modify computer chips in their vehicles' computers, called electronic control units, or ECUs, to get better performance, efficiency and fuel savings. Online, these chips are available for a few hundred dollars… John Storey, an automotive and emissions expert at Oak Ridge National Laboratory, [put] the figure of "chipped" models between 40 and 60 percent of all diesel pickup trucks in the United States… "These are completely illegal, but no one ever gets caught," he said.[373]

The mechanic also suggested that the popularity of aftermarket chips might be the reason that my car's emissions test did not directly measure emissions. Rather, the

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[372] Chris Buckley, "China Burns Much More Coal Than Reported, Complicating Climate Talks," *The New York Times*, November 3 2015. http://www.nytimes.com/2015/11/04/world/asia/china-burns-much-more-coal-than-reported-complicating-climate-talks.html?_r=0

[373] Benjamin Julac, "Volkswagen Uses Software to Fool Epa Pollution Tests: Epa Charges That the German Automaker Installed Emissions-Control Software Designed to Work Only During Tests," *Scientific American*, September 21 2015. https://www.scientificamerican.com/article/volkswagen-uses-software-to-fool-epa-pollution-tests/

"test" amounted to an inspection to see that nothing had been tampered with. I had not tampered with anything—but my car leaks tremendous amounts of oil.

A full page Volkswagen advertisement in *Sunset*,[374] the travel and leisure magazine ubiquitous in U.S. waiting rooms, provides a cautionary message from an unlikely messenger [image 8, page 163]. The tag line reads, "Just because you don't see it, doesn't mean it isn't there." The reader needs to examine the fine print in order to discern that the invisible object to be inferred is another car, the shadow of which is visible next to the silver Passat that is the centerpiece of the photo—the feature being touted is the "Blind Spot Monitor." Given the timing of publication, only a few months after the Volkswagen scandal had broken—it is difficult to view the ad without imputing other invisible yet potentially consequential entities. Other tag lines would be just as fitting: just because you don't measure it, doesn't mean it isn't there; and, just because you do count it, doesn't mean it is there.

[374] Advertisement, *Sunset*, March 2016. 5.

Image 8) Volkswagen Advertisement

Colonialism

> *Actors in the development industry have jumped onto carbon as a vehicle for them to promote their specific agendas of development, conservation, and the like, either through the market or participatory means.*[375]

Since its third assessment, the IPCC has emphasized the unequal distribution of the dangers of climate change, noting that the populations most vulnerable to even small climate changes are more likely to be poor people in developing countries.[376] It is frequently also noted that developed countries bear the bulk of the responsibility for historic emissions, and that the trappings of developed lifestyles (e.g. from automotive commuting and electricity usage) typically have far greater emissions than lifestyles in “less developed” places. As this dissertation details throughout, a variety of technocratic “carbon” projects have emerged, and are often framed as a means of rectifying these the inequitable foundations. For instance, in the mid-1990s an academic and neo-classical economist, Graciela Chichilnisky, promoted the idea of carbon markets as a means to redistribute wealth to the global south to officials at the UN and in the U.S.[377] The UN CDM was developed with the aim of simultaneously promoting “sustainable development” and reducing C_{GHG} emissions. Ample evidence, however, suggests that the aggregate result of technocratic carbon offsetting projects is not sustainable development or climate mitigation, but “carbon colonialism.”[378]

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375 Dalsgaard. 87.
376 Liverman. 284.
377 Lohmann, "The Endless Algebra of Climate Markets."94.
378 Kevin Smith, Oscar Reyes, and Timothy Byakola, *The Carbon Neutral Myth: Offset Indulgences for Your Climate Sins* (Transnational Institute Amsterdam, 2007).

The trends with regard to dams provide an illustration. In the 1980s and into the 90s, hydroelectric dams gained a reputation as both unecological (e.g destroying river ecosystems) and counterproductive development projects (e.g. they often displaced rural communities that had previously depended on river ecosystems).[379] As CARBON discourse became dominant, however, the perception of dams took "a new turn," as their capacity to produce renewable (therefore "green") energy was touted.[380] Following that logic, the UN CDM has supported the construction of hundreds of large-scale hydroelectric dams with carbon credits. Hydropower produces more than 80% of worldwide renewable energy, and is responsible for the majority of CDM projects overall. [381] The distribution of CDM dam projects is highly unequal, however, excluding many of the poorest nations, while more than 80% of the projects take place in China, India, and Brazil, suggesting shortcomings with regard to its success at encouraging financial transfers to the most "underdeveloped" locations (assuming that such transfers would benefit the people most in need and not merely elites).

Erlewein's appraisal of CDM sponsored Dam projects describes several examples of the local effects of offsetting-dams that are "socially and/or ecologically harmful and may result in the exacerbation of existing inequalities."[382] In addition,

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[379] Alexander Erlewein, "The Promotion of Dams through the Clean Development Mechanism: Between Sustainable Climate Protection and Carbon Colonialism," in *Large Dams in Asia* (Springer, 2014).149-150.
[380] Ibid.
[381] Ibid. 150.
[382] Ibid. 163.

Erlewein finds that CDM is “based on hardly verifiable additionality criteria and unclear sustainability aims” and “fund[s] ineffective or… potentially counterproductive projects which tie up financial resources that could be invested in more climate friendly and more sustainable technologies.”[383] Despite these criticisms, Erlewein implies that the CDM could be salvaged, arguing that “it has to be ensured that non-additional and unsustainable projects are excluded from the CDM as far as possible.”[384] Many critiques of the logic and incentives built into the CDM and similar projects (illustrated throughout this dissertation), however, provide reason to doubt that Erlewein’s hope is a realistic possibility, and further support the argument that they are a form of climate colonialism.[385]

The debate regarding whether market-based approaches are appropriate and efficient versus neo-colonialist and ineffective, is articulated through rival “carbon” calculations. The frames laid out in 1991 by the Center for Science and Environment (CSE), based in Delhi, and World Resources Institute (WRI), based in Washington, have guided and continue to encapsulate the positions. WRI’s accounting for GHG “budgets” was based in estimations of contemporary national emissions. For Northern, post-industrial states, this base-line amounted to a discount for high-polluters; For the developing South, such a system appeared to penalize (energy intensive) rapid development. CSE challenged WRI by calculating national emissions budgets based on an equal, per capita allotment. The per capita frame enabled CSE to

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[383] Ibid. 165.
[384] Ibid. 165.
[385] See: Bond. Also: Lohmann, "Marketing and Making Carbon Dumps: Commodification, Calculation and Counterfactuals in Climate Change Mitigation."

illustrate their argument that the developing climate governance approach was colonialist through quantified terms that translated easily to make a rhetorical case with regard to the ethical dynamic between North and South: e.g. the climate impact of the average American was nineteen times that of the average Indian.[386] (As an afterward, it should be noted that the 2015 Paris COP agreement has moved away from the notion of a system for calculating national emissions caps, replacing that framework with states voluntarily pledging a reduction of their own choosing. I.e., assuming that a global "carbon" agreement could be effective, the standards have become less stringent.) To sum up, the implication of these neo-colonialist dynamics is that the impact of global climate governance efforts has been more consequential for humans—and in a manner following familiar patterns of inequality—than climate.

Conclusion

Several years ago, a local grocery store in Santa Cruz moved from its old, cramped location to a newly constructed building. The grand opening touted the many ecological elements of the new building's design, and the cloth grocery bags that clerks occasionally give to customers (free with a minimum $50 purchase) are printed with an overview of Staff of Life's green credentials. A large sign [image 9, page 168] has been hanging over the cash registers since the opening. It suggests that customers "Carbon Offset Your CO_2 Emission To and From Staff of Life today!" by advising their cashier "how many miles you drive to and from Staff of Life." The

[386] Blok. 467.

funds, "only 25c per mile," would go to a local program to "encourage sustainable transportation choices in our community." In addition, the program also promises to track the sustainable trips that result from its initiative, "thus calculating [the] reduction of CO2 into our environment." Recently, standing beneath the sign and pointing up at it, I asked the clerk (who I recognize as a long term employee), "does anyone ever do that?" She looked confused, looked up, and said something to the effect of "no, maybe a couple of people tried when we first opened, but not really."

Image 9) Carbon Offset Sign at Santa Cruz, CA grocery store

I suspect that a donation jar labeled with the name of the program, and a simple statement of its mission, would have brought in many more funds than this sign—which likely cost more to produce than it has raised for the cause. Yet, the sign remains, in a store with an earthy, "natural" reputation, in a town that is known for the same. The sign continues to convey to shoppers that they are shopping somewhere green, and therefore it helps confirm the beliefs of the shoppers that they are the type of people who care about the environment. In this example, just as this chapter has illustrated throughout, many attempts to reduce "carbon" emissions have done next-to-nothing to tackle the climate crisis.

If an approach to climate change that uses CARBON as its foundation does not lead to reductions in $C_{anthropos}$, then CARBON is evidently, evaluated on its own terms, a rather ineffective device. This prompts a question for climate activists to ponder: could a CARBON based strategy be counterproductive to their efforts? That is, has CARBON, as the discursive underpinning of climate depoliticization (in the guise of remediation) obfuscated other potential paths? With this question in mind, the next chapter analyzes the role of CARBON in environmentalists' own understanding of the political quagmire surrounding climate.

Carbon Compulsion

Introduction: Understandings of the Climate Change Problem

The previous chapter, “carbon chains,” concluded that “carbon” facilitates the current state of ecological paradox, in which people act “on climate” or display climate concern quite frequently, but not much of climatic consequence comes of these intentional actions. This chapter examines how climate activists reckon with this paradox. In other words, the disjuncture between the enormity of human intention and effort regarding “carbon”/climate and the desultory progress on and prognosis of the climate, has for some time resulted in lamentations regarding the state of climate politics. This chapter analyzes how activists themselves explain this failure, and what role “carbon” plays in these understandings.

Before climate change activism arrived in its now stuck position, climate change itself had to come to be understood as a political problem. Although climate change has at this point become a perennial fixture on the roster of political problems around the world, it has not always been understood as such—and indeed there are plenty of people who even today question whether climate change is indeed problematic (or even “real”). That climate change was (and occasionally still is) not always considered an appropriate matter for the political realm is a reminder that political problems are not given this label and the attention it bestows because their problem status is factually given, but rather they *must come to be understood* as problems. The manner in which they come to be understood as such is tremendously consequential for what solutions are proposed and how they are received.

This approach to political analysis, emphasizing "problem definition," has been thoughtfully applied in explanations of policy formation, though this chapter will adapt the framework to describe discourse beyond the policy realm. Stone,[387] discussed below, developed this approach to explain policy formation in many issue areas.[388] Litfin[389] (discussed at length in the "ozone antecedent" section of chapter one) has used Stone's approach to the case of the Ozone regime. While Stone and Litfin have applied the term "discourse" rather narrowly to describe particular *policy* discourses, Foucault's conceptualization of discourse is much broader than the policy realm (see discussion in the introductory chapter), so a discourse approach need not limit itself to policy discourses. This chapter follows the broader conception of discourse as including but also moving beyond policy. Given that the dominant discourse of the climate problem, CARBON, is preoccupied with matters of policy (i.e. depoliticized), its rival counter-discourses do not easily fit the mold of policy discourses. One strand of competing counter-discourses denies the problem and the need to address it through policy (denialism), and another strand emphasizes "political," i.e. non-policy focused, approaches to the climate problem (e.g. challenging capitalism or consumerism).

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[387] Deborah A. Stone, "Causal Stories and the Formation of Policy Agendas," *Political Science Quarterly* 104, no. 2 (1989).
[388] Deborah Stone, *Policy Paradox: The Art of Political Decision Making*, revised ed. (New York: W.W. Norton & Company, 2002).
[389] Litfin.

As Stone argues,[390] causal ideas—conveyed through stories that describe harms, attribute blame, and thereby claim that government action should rightly be taken to remediate the situation—are necessary to transform something that has more typically been perceived as a difficulty or curiosity into a political problem. Once something has reached the status of political problem, ongoing attempts by different actors to re/construct this story continue in a struggle to influence policy formation. Rival stories attributing global warming to human versus natural factors (e.g. $C_{anthropos}$ emissions versus sun spots) and industrialized versus developing countries (e.g. historical "carbon" emissions versus contemporary rates of increase of national emissions) are examples of the ongoing political conflicts over what should be done about climate change, which take the form of different causal stories that offer rival explanations for what and who is responsible for causing climate change. Although these fights are, superficially, factual disputes over what is the "real" cause of the problem (or questioning the reality of the problem itself), they are "more than empirical claims about the sequence of events. They are fights about the possibility of control and the assignment of responsibility."[391]

Causal stories that are the most politically effective point to purposeful actions that lead to intended consequences, whereas causal stories that are the least effective (i.e. unable to target blame and respond to it with policy) point to unguided actions that have unintended consequences.[392] This difference is due to the powerful

[390] Stone. *Causal Stories.*
[391] Ibid. 283.
[392] Ibid. 283-289.

conceptual delineation between natural and social,[393] which Stone identifies as our "two primary frameworks for interpreting the world."[394] The more that a cause of a situation is associated with physical action, fate, a lack of willful action and intention, or accident the more it is considered natural—and all of these characteristics of a natural causal story create doubt that something can be done about the problem. Conversely, the more that the causal story describing a situation can be identified as social—as a problem resulting from a strong linkage between the will or intention of human beings and their actions—the stronger the case that these actions can be influenced and therefore that a policy response is justified. In short, the aim of a causal story in politics is to conceptualize a situation as a problem by moving it "intellectually from the realm of fate to the realm of human agency."[395] As this chapter will show, this dynamic is particularly important for understanding the causal stories that emanate from CARBON.

In order to contend that climate change politics has failed, but could succeed, one must believe that the problem can be responsive to purposeful human action. Therefore, it makes sense that activists emphasize the *anthropogenic* basis of climate change when they frame it as a political problem. If a scientific consensus existed that global warming was occurring because of natural, and not anthropogenic causes, it would no doubt garner much less political attention, even assuming that it was

[393] Relatedly, Science and Technology Studies has established the powerful consequentiality of the notion of separate spheres of nature and society, while also demonstrating how the process of co-production between/among nature-cultures. Jasanoff.
[394] Stone. *Causal Stories.* 283.
[395] Ibid. 283.

anticipated to have the same undesirable consequences that the scientific consensus currently attributes to anthropogenic climate changes (e.g. rising sea levels, threats to species, more unpredictable and often undesirable weather patterns, etc.). This leads Wynne to ask:

> If the relative importance of the human contributions compared with the non-human ones is unknown, perhaps unknowable, do we then still assume responsibility for our part, or fatalistically declare that there can be no human responsibility if sun-spots and other factors way beyond human agency are also influencing climate?[396]

To the extent that this hypothetical "natural" climate change would be able to register on political agendas, with no one to blame it would be difficult to identify a party responsible for taking action. The politics following this hypothetical might surround geoengineering responses—i.e. whether or not humans should proactively intervene in the "natural" course of events. If activists follow the model of politics that Stone has described, we should expect climate activists' causal stories to portray humans as having acted (or at least, since gaining the knowledge of climate change, continuing to act) with willful agency in the creation of the problem, as well as having the capacity to take purposive action that would remediate it.

Climate change, of course, is a difficult issue to firmly distance from the realm of natural causal stories and entrench in the realm of social causal stories, due to the immense complexity that the portrait of the problem painted by the scientific consensus entails. Although the problem can be described as a simple one of "carbon," "carbon" strings together practically infinite interactions —smokestacks,

[396] Wynne. 293.

monetary exchanges, gas pumps, the chopping down of trees, the exhalations of humans, the rear expulsions of cows, the tails of jet planes, etc. –with the socio-technical arrangements that influence when, how and to what extent these phenomena occur. The following excerpt from a *New York Times* article, linking the distribution of carbon emissions with market incentives, illustrates the complexity that is endemic to most any causal story of climate change:

> Virtually every automobile ride, every plane trip and, in most places, every flip of a light switch adds carbon dioxide to the air, and relatively little money is being spent to find and deploy alternative technologies.[397]

Stories of complex causation (such as this), as Stone notes, tend not to be as politically effective for reasons that mirror the ineffectiveness of causal stories rooted in the natural rather than the social:

> They postulate a kind of innocence, in that no identifiable actor can exert control over the whole system or web of interactions. Without overarching control, there can be no purpose and no responsibility. Complex causal explanations are not very useful in politics, precisely because they do not offer a single locus of control, a plausible candidate to take responsibility for a problem, or a point of leverage to fix a problem.[398]

This statement has two significant implications for this analysis of the stagnation of climate change politics. First, the most accurate descriptions of the causation of the climate problem, i.e. those that acknowledge its enormous complexity, are politically difficult to translate into public policy.

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[397]Gillis. http://www.nytimes.com/2013/05/11/science/earth/carbon-dioxide-level-passes-long-feared-milestone.html?ref=science&_r=1&

[398] Stone. *Causal Stories.* 289.

Second, “carbon,” at first glance, would seem to have some qualities that would compensate for the first difficulty. Whereas the complexity of climate change means that no single, straightforward candidate to take responsibility for the problem is immediately evident,[399] “carbon” seems to offer this single locus for control (albeit through multiple channels) by acting as a common point of leverage.[400] “Carbon,” however, is an unusual political object (as much of this dissertation attests), and the politics that are attached to it do not follow in the mode of more easily identified agents of responsibility that are the antagonists of simpler causal stories, such as negligent corporations or autocratic rulers.

The difficulty of creating a robust causal story out of the complex causation of climate change helps explain the appeal of the simplifying CARBON discourse. The epic failure of climate politics to mount a successful response to the problem (as of yet), despite CARBON, suggests two lines of inquiry: 1) Why has the “carbon” based response been an ineffective patch for the difficulty that the complexity of climate poses for creating a politically effective causal story? 2) Given its poor political performance, why have climate activists largely maintained their allegiance to CARBON? The answer to #1 has already been largely answered by chapter two: “carbon” does not work in the world in the manner the discourse envisions. Put differently, the causal story that is projected by CARBON actually does a reasonably

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[399] e.g. it is difficult to place blame solely with nation states when consumers, historical actors, a single industry, developing countries that are projected to have much high emissions in the future, the United Nations, or others that could be easily charged as well.

[400] The reasons that “carbon” appears to be able to serve as this locus are elaborated upon in the glossary and chapter one.

good job of fulfilling its duties: it identifies pathways for assigning responsibility for the problem that are amenable to policy solutions. The difficulty is that "carbon" itself does not cooperate with these policy solutions. With regard to #2, this question guides the investigation here. From this starting point, this chapter examines the narratives that climate activists give to explain the political failure to respond to climate change.

Considering the combination of the complex problem of climate and the CARBON based framework of proposed solutions, it is not surprising that the following analysis finds that activists' explanations of the disappointments of climate change politics are apt to be varieties of the claim that somehow, something or someone gets in the way of properly accounting for "carbon." The role of these narratives in the strategizing of climate activism is illuminating in a manner similar to the role of causal stories in problem definition. On the whole, these narratives place blame for the political quagmire with actors (e.g. skeptics) who *impede* the "carbon" imperative from being rendered into policy. Much like the case of ozone negotiations that Litfin describes, however, what is important here is "the structure and content of discursive practices, a subject that is easily ignored when the roles of specific agents is overemphasized."[401] By placing the blame on actors that get in the way, activists neglect to evaluate whether the thing that they get in the way of—the widespread implementation of "carbon" based governance—is itself up to the task. It is important to understand the explanations for the failure of climate politics that are held by those

[401] Litfin. 189.

who are attempting to take action, as these ideas no doubt inform the actions they pursue. The possibility that common constructions of the problem contribute to its perpetuation is itself an important consideration in this dissertation's investigation of the shortcomings of climate politics and "carbon's" role within.

Chapter Organization

The remainder of this chapter presents an overview of conventional explanations of the failures of climate politics. It examines explanations from commentators of all stripes. Given that this is a political subject, the explanations given by academics from political science and related disciplines are well represented. For obvious reasons, the explanations of climate scientists are featured as well. Many others, including prominent political figures, representatives of organizations such as environmental groups, or ordinary people (e.g. through public opinion polls) are also included in the analysis.

Who does the explaining, however, turns out not to offer much help in understanding climate discourse as it relates to this investigation. For example, cries that "people need to vote out politicians who are hostile to regulating carbon" or "the United Nations should pass a climate treaty" are the types of statements commonly heard from the lips of climate scientists, political scientists, and others. Other possible cleavages, e.g. examining levels of analysis (global, state, regional, local, etc.), similarly, have little to offer this investigation. That is, examples from different scales are woven throughout, but there does not appear to be a relationship between the scale at which action is proposed and which category of explanation is given. Given the importance of defining problems as social, as opposed to natural, in constructing an effective political frame that identifies human agency as capable of addressing the problem, the proceeding analysis focuses on implicit agential assumptions of explanations of the failure of climate change politics.

Accordingly, this examination identifies five prominent strands in the body of explanations of the failures of climate politics: 1) human beliefs and intentions, 2) dissimulation by skeptics that obscures expert knowledge, 3) social impediments to technological fixes, 4) faulty incentive structures, and 5) the possibility that the problem is "not solvable." These five categories differ from one another, most importantly, with regard to how they conceptualize agency—which is differentially filtered through "carbon." This partitioning should be approached as a heuristic that is helpful for understanding how commentators make sense of the political intractability of climate politics, not a perfect representation; sliced from another angle, we would be left with a different image that could further our understanding in other regards.

Each of the five types of explanations is described in turn, beginning with the category that has the strongest conception of human agency (human beliefs and intentions), and ending with the type that describes human agency as the most constrained (the "eight-hundred-pound elephant in the room" that acknowledges the possibility that the problem may not be solvable). Within each of these five segments, the characteristics of the explanation are described and the explanation is illustrated with examples. The function that each explanation assigns to "carbon" is highlighted.

In addition, related variants on the explanation are given and the philosophical tensions are identified, allowing for an evaluation of the explanatory value and shortcomings of the explanation.

Two caveats are in order. First, these explanations are often layered with one another, and frequently presented additively. Only in rare instances do they seem to come into competition with one another in their originating contexts—some examples in which both of these are the case are given in the conclusion. Second, the boundaries between the five categories involve a metaphorical gray area. In other words, these categories are simplifications that are valuable for distilling and thus enabling a better understanding of what is, in "reality,"[402] a much messier and more complex world. One price of this simplification is that it can seem to obscure areas of overlap between these explanations, such as how human intention runs through them all, though it is discussed primarily in the first explanation, where it is given the most weight. By outlining some of these instances of overlap, the chapter's conclusion compensates for these shortcomings. In their totality, these categories of explanation are all different iterations of how knowledge or beliefs about the world do not synchronize with the political organization of the world.

The chapter's conclusion notes the theoretical implications that derive from the explanations' comparison, envisioned on an agential spectrum. The flexibility of "carbon" means that climate activism can paint multiple and contradictory portraits of responsibility and agency while seemingly staying on the same CARBON page;

[402] The reason for quotation marks here is made apparent in the next chapter.

therefore, the dominant discourse of climate change encapsulates these contradictions. Counter-intuitively, the assumption that there is a fix (or perhaps an aggregate of fixes) to be found through designing policy, technology and society for "carbon" reductions—may itself hinder efforts to combat climate change. The difficulties of agential determination point to an ontological dimension of climate politics that is taken up in the subsequent chapter.

Explanations of the Shortcomings of Climate Activism

Human Beliefs and Intentions

When Ira Flatow, host of NPR's nationally syndicated *Science Friday,* presented a segment on the failure to pass climate legislation in the U.S. in 2010, he placed blame with a lack of effort and passion by the environmental movement. He asked, "Have the greens run out of steam? Has the environmental movement lost the drive and the anger that propelled it in the '60s and '70s?" He also assumed that public sentiment of concern about global warming was further evidence that legislation could have been passed, and thus further evidence of movement failure. Flatow lamented that "it seems like it would be easy to rally a couple hundred thousand people to get them to call their representatives to pressure congress to act, especially when polls say that most people are concerned about global warming," images of an enormous oil spill [Gulf/BP/Horizon] have saturated the news, and in the midst of a summer of record heat,[403] "but that didn't happen."[404] Flatow's comments are an example of one category of explanations for the failures of climate politics—the notion that human beliefs and intentions are not sufficiently on the side of fixing the problem.[405] This explanation assumes that the necessary climate policies would get passed if only more people had higher levels of concern about global warming.

This explanation is based in the notion that it is human mindsets—attitudes, consciousness, desires and beliefs—that are the crucial, direct driver of human action. Within environmental thought, this orientation has long been captured by a stream that blames environmental problems on anthropocentrism.[406] The anthropocentric critique hinges primarily on a conception of nature and culture as fundamentally misaligned, and argues that the two can be brought into harmony through a correction in human attitudes, i.e. through humans rectifying their selfishness, which comes

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403 Studies have shown that public concern about climate change does ebb and flow with the weather. It should, however, be noted that no individual weather event can scientifically be attributed to climate change, and that climate change makes both heat waves and large snow storms (which are associated with diminishing public concern over global warming) more likely. Especially given that this is a program devoted to science, it is odd that Flatow would let go of scientific accuracy, which only reaffirms the strength of his assumption that attitudes and beliefs (i.e. that climate change is bad) are what matter most for bringing about action.
404 "Time to Get Tough, Environmentalists Say," in *Science Friday* (http://www.npr.org/templates/story/story.php?storyId=129629736: National Public Radio, 2010).
405 There is some asynchrony in Flatow's logic; he is arguing both that "the people" want to fix the problem, and that "the people" do not care enough to follow through on their beliefs with action.
406 See, for example: Robyn Eckersley, *Environmentalism and Political Theory: Toward an Ecocentric Approach* (Albany: State University of New York Press, 1992). Also, John S. Dryzek, *The Politics of the Earth: Environmental Discourses*, 2nd ed. (New York: Oxford University Press Inc., 2005).

necessarily at nature's expense. In other words, anthropocentrism and other consciousness-based explanations of political failure on climate are an offshoot of the old adage "where there's a will there's a way." Research from various orientations, however, undermines this assumption. For example, Guber's study of U.S. public opinion and the environment finds a strong consensus for environmental protection (when questions are asked straightforwardly), but that agreement has not fostered environmental laws of comparable import.[407] Furthermore, she notes, "there is a gap between what people say and what they do environmentally."[408] Olson's collective action problem illustrates the point as well: while many people may share similar aims, if those aims require collective action, then problems such as "free-riders" may get in the way.[409]

Looking at the climate example in particular, there is plenty of evidence of the will to tackle the problem, yet the way has not seemed to follow. For example, Wainright and Mann suggest that states do not fail to act because the elite actors who govern them lack the will to do so—instead they propose that these elites do possess this motivation—in no small part because they desire "to stabilize the conditions that produce their privileges"—but note that, nonetheless, "they have utterly failed to coordinate a response."[410] Psychologists typically accept the proposition that sufficient will to tackle the problem is a necessary precursor to action, but also

[407] Deborah Lynn Guber, *The Grassroots of a Green Revolution* (Cambridge, Massachusetts: The MIT Press, 2003).
[408] Ibid. 91.
[409] Mancur Olson, *The Logic of Collective Action: Public Goods and the Theory of Groups*, vol. 124, Harvard Economic Studies (Cambridge, MA: Harvard University Press, 1971).
[410] Wainwright and Mann. 4.

"blame our brains" for making it difficult for us to fully grasp climate change as a threat.[411] They point to such factors as our difficulty in conceptualizing climate change as an enemy because it does not come in embodied form, and our difficulty in accurately perceiving gradual change as opposed to rapid change, which has the effect of normalizing climate change rather than treating it as a threat.[412]

Psychologists also contend that, even when people do overcome these barriers and come to perceive climate change as threatening, additional cognitive dynamics often "create dissonance between our actions and beliefs."[413] They point to the difficulty of facing the psychic pain of caring about a planet that is being destroyed, or the emotional stress of caring about both the planet and one's way of life (a hint of the elephant to be discussed later), and knowing that the two are in conflict with one another. Some psychotherapists have begun specializing in this area, offering counseling to patients who are troubled about climate change. One therapist has begun Carbon Conversations,[414] a program based in the United Kingdom that is akin to group therapy and focuses on the goal of participants halving their personal carbon footprint while they "deal with the difficulties of change by connecting to values,

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[411] "Blaming our brains" is, in another sense, an argument that "nature" has determined human (lack of) reaction to climate change. Nonetheless, the argument is primarily an explanation grounded in the primacy of intentional human agency, implying that the correct course of action is to use knowledge and human will to overcome the impediments that are posed by structures of cognition. This tension within human minds—that someone lacks control over their thoughts—foreshadows the discussion of determinism/contingency in the next chapter.

[412] Paramaguru. http://science.time.com/2013/08/19/in-denial-about-the-climate-the-psychological-battle-over-global-warming/

[413] Ibid.

[414] The Surefoot Effect, "Carbon Conversations," http://carbonconversations.org/what-carbon-conversations.

emotions and identity."[415] Although this last example links beliefs and intentions with actions, the program is itself a response to a depressing sense of powerlessness that is often felt in the face of climate change (and a halving of individual emissions nonetheless still means that one is contributing to the problem, only less so than before). In short, the consciousness explanation of climate political failure tends to overestimate the power of the will and underestimate the challenge of determining the way. Put differently: a will does not necessarily find a way.

Agency in this conception is strongly rooted with human intentions. In the human beliefs and intentions explanation of failure, "carbon" becomes a reflection of, and outlet for, human action. Yet, this strong conception of human, intentional agency struggles awkwardly to be maintained when the idea that a response to climate change is a necessity is simultaneously articulated. For instance, on the opening page of the aptly titled *Our Choice*, Al Gore writes that there is a risk that despair in the face of "the unimaginable catastrophe that would unfold on this planet if we don't start making dramatic changes quickly" could keep us from "avert[ing] the worst impacts." Therefore, "we need to make our choice to act now."[416] By emphasizing despair, Gore keeps conscious human agency in the forefront, but the sense of urgent necessity strongly implies that there is actually little choice but to act. Moreover, the form of that action seems already to be prescribed: "the real solution would include both a CO_2 tax and a cap and trade system, and I believe that will eventually be our

[415] Ibid.
[416] Gore, "Our Choice: A Plan to Solve the Climate Crisis." 13.

choice."[417] The presumption is that if humans properly and sufficiently care about the climate then the movement of "carbon" to the right locations will naturally and easily follow and come into alignment with "collective will," which is "the only missing ingredient."[418]

This points toward a pervasive theme in these consciousness-based explanations of the failures of climate politics: the tension between the individual and the collective. As Gore writes:

> The key first step toward a [climate] solution is this: we must make a choice. By *we,* I mean our global civilization. And therein lies, as Shakespeare named it, "the rub"—because it seems absurd to imagine that we as a species are capable of making a conscious collective decision. And yet that is the task we are now confronting.[419]

Individuals are important as well: "Each of us as an individual has a part to play, of course, and the actions we take in our own lives, households, and businesses are extremely important." He continues, "individuals eager to become a part of the solution must become active as citizens in advocating and fighting for the new laws and treaties that will ultimately lead to the necessary global-scale solutions."[420] The question that lingers in the wake of this tension is what arrangement between individual and collective is needed. Some imply that every individual must be on board, as individualism, taken to its extreme, would imply; others indicate that it is a critical mass, but not *all* individuals that need to be convinced. If a critical mass is what is needed, the

[417] Ibid. 345.
[418] Ibid. 15.
[419] Ibid. 16.
[420] Ibid. 18.

level and rationale for such a threshold is debatable. For example, one prominent climate modeler (who is also a climate activist and psychologist), argues that the climate concerned need not convince everyone to come to their side, but rather 67% would suffice to push through the necessary policy in the U.S.[421] This reductive reasoning is too simplistic, failing to account for the complexities of democratic politics, such as single issue voting, polarization, divided government, federal systems, and legal constraints on what regulations are possible.[422] Explanations reliant on human beliefs and intentions are likely to acknowledge but not prioritize these other factors.

This difficulty with explaining the failure of climate politics as a reflection of attitudes and beliefs also, somewhat ironically, can lead to questioning whether individuals' beliefs are truly their own. For example, in Theda Skocpol's explanation of the failure to pass U.S. cap and trade legislation in 2010, she blames a lack of public engagement on the climate issue, and especially the anti-climate action passion of popular forces on the right, but finds it "hard to avoid the conclusion that popular climate-change denial was deliberately stoked from above." This in turn raises

[421] Jeff Kiehl, speaking at "Moral Dimensions of Climate Change" Conference at Peace United Church of Christ, Santa Cruz, CA: February 6, 2016.
[422] For example, the Obama administration's "Clean Power Plan," to reduce CO_2 emissions from coal plants, often spoken of as the centerpiece of his environmental legacy, was put on hold by the Supreme Court after a group of states sued, contesting whether the regulations are appropriate under the Clean Air Act. The case is now making its way through the appeals process, and will likely be heard by the Supreme Court in the end.

questions of whether it is attitudes and beliefs that are important, or if beliefs are a reflection of greater political forces, and less important in their own right.[423]

Dissimulation by Skeptics (& the Obfuscation of Expert Knowledge)

These days, publishers and producers of newspapers, magazines, radio programs, and the like, make their content accessible on the web, followed by the infamous comments section, which allows viewers to weigh in on the coverage, register criticisms, and have conversations (or, in many cases, engage in rude comments) with one another. Most any story posted by a major mainstream news organization on the web that begins from the position that the threat of climate change is *real* (typically these mention the scientific consensus of climate science), is followed by comments that challenge this proposition on a number of grounds. The following comments in response to a Time Magazine article are illustrative and typical:[424]

> 1) People who believe man is causing climate change are the same type of people who believed witches caused the Little Ice Age in the 1600s. It's completely irrational to believe that somehow THIS climate change has a different cause than all the thousands that preceded it throughout the millenia of Earth's history...all that occurred without any help by man.
>
> 2) There is no change. Sorry guys but stop making this stuff up.
>
> 3) The no. of scientists that disagree is growing. New scientific findings are not recognised by the socalled consensus group. NASA referenced statements are outdated. Real scientists does not postulate theories with high degree of security as those in cooperation with IPCC. The earht climate system is

[423] Theda Skocpol, "Naming the Problem: What Will It Take to Counter Extremism and Engage Americans in the Fight against Global Warming," in *Symposium on the Politics of America's Fight against Global Warming* (Harvard University, 2013). 84.
[424] Paramaguru.

complex and among all influenced by the solar activities and distance to the sun which varies over time.

4) This Time Magazine article is simply idiotic. If the "climate threat" were as compelling as indicated then why are the underlying, related and vastly more severe threats to terrestrial, oceanic and atmospheric carrying capacity not at least equally informing and motivating our collective global response? The answer is that by narrowly defining climate change as the essential and proximal threat to the earth, the response can be similarly narrowly defined as geo-engineered climate modification.

5) ALGORE is my shepherd; I shall not think.
He maketh me lie down in Greenzi pastures:
He leadeth me beside the still-freezing waters.
He selleth my soul for CO_2 [sic]

Although the "conversation" on this platform (and others like it) is certainly lacking on a number of counts (such as intellectual rigor and emotional maturity), it shows that opposition to climate activism is alive and well. No matter the consensus, the persistence and pervasiveness of this oppositional response continues to reaffirm climate change as a politically controversial issue. The question is to what extent this denial contributes to the failings of climate politics. It is often claimed that it does.

Michael Mann, an atmospheric scientist who has become a public figure and spokesperson for the climate science consensus, lays much of the blame with denialism. Mann was thrust into the spotlight because his research contributed to the now iconic "hockey stick" graph, which depicts the average global temperatures for the most recent millennium. The trend is frequently described as following the shape of a hockey stick laid on its shaft, showing a warm medieval period, followed by the cooler period of the little ice age, with a sharp spike at the end that indicates dramatically warmer temperatures following the industrial revolution. The hockey stick succinctly communicates the message that the most recent trend of global warming is dramatic and coincides with large-scale intensification of human impacts, and has been well publicized, especially since it was featured in the 2007 IPCC report. "Climate contrarians," as Mann describes them,[425] have sought to discredit this symbol of climate change as scientific fact in part by challenging the credibility of its authors. In 2009, Mann's emails were hacked, and excerpts from those emails were in the media spotlight during the Climategate scandal.

Mann sees Climategate as one battle in the ongoing war. On one side are climate contrarians who seek to discredit climate science through "a massive disinformation campaign funded by powerful interests" and are driven by the "single goal," "to thwart efforts to regulate carbon emissions."[426] On the other side are climate activists, who Mann portrays as crusaders trying to save the world by fighting climate contrarians through a concerted effort to publicly defend their science. It is not an exaggeration to say that Mann views this as a battle of good versus evil. He opens the epilogue to his book *The Hockey Stick and the Climate Wars* (which is a response to Climategate) with a well-known quote attributed to Edmund Burke: "All that is necessary for the triumph of evil is that good men [and women] do nothing."[427] Mann obviously cares deeply about this cause, and wholeheartedly believes the warnings of climate science.

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[425] Michael Mann, *The Hockey Stick and the Climate Wars: Dispatches from the Front Lines* (New York: Columbia University Press, 2012).
[426] Ibid. 254.
[427] Ibid. 249.

His penchant to place so much blame with the efforts of skeptics to discredit climate science, however, is founded in a dubious assumption about why climate change politics is failing; that the science would be much more readily translated into appropriate policies if only the deniers did not muddy the waters. Science, however, does not automatically translate into policy (just as will does not automatically bring about a way to act). Determining policies that are scientifically appropriate, and foreseeing the potential consequences thereof, is challenging, time-consuming, uncertain and political.[428]

Mann does briefly acknowledge that "the professional climate change denial machine"[429] is "not the only reason for the delay in action," but calls it "a major contributor"[430] and does not explicitly elaborate on other reasons or their comparative importance. He does give oblique indications of what other reasons might be included, e.g. his acknowledgement that the Copenhagen round of climate talks probably had so little success not because of the Climategate controversy (which was fresh during the talks), but because of "the nagging political complications and competing economic interests of different nations" that will "hopefully" be overcome.[431] He further specifies that "carbon emissions… are fundamental to the prevailing world economy" and "[e]nding our addiction to carbon-based power requires a fundamental revision of our energy infrastructure and a substantial shift

[428] Sheila Jasanoff, *Designs on Nature: Science and Democracy in Europe and the United States* (Princeton, New Jersey: Princeton University Press, 2005).
[429] See footnote 438, which elaborates upon the concerted effort to promote denialism.
[430] Mann. 250.
[431] Ibid. 252.

from our current lifestyle." The implication is that, even if deniers did not stand "in the way," fixing climate change would still be a monumental undertaking, and monumental undertakings are not easy.

This acknowledgement, skirting the elephant, is uncomfortable, as Mann's brief acknowledgment of other factors seems to undermine his core proposition that denialism is the evil obstructer of climate reform. That is, if the enormity of the change that is required to combat climate change itself is cause to doubt the amenability of the problem to solutions, then by comparison how significant a contributor to the failure of climate politics is denialism? In other words, much besides denialism stands in the way of climate action, but many of these other causes—e. g. the economic incentive structure that guides the actions of billions of people—make less convenient targets for blame, as it is difficult to pointedly respond to such a broad phenomenon. These intricacies, however, are for the most part overshadowed by Mann's moralistic portrayal of the climate "wars." His statement that "there is nothing more noble than striving to communicate, in terms that are simultaneously accurate and accessible, the societal implications of our scientific knowledge,"[432] reaffirms that the heated politics of climate change are not merely a dispute about facts, but about deeper moral and ideological matters.

Mann characterizes the contrarians' skepticism as motivated by ideology, and strongly intimates that the rationales that skeptics employ are intellectually disingenuous. To give one example:

[432] Ibid. 253.

> The controversy that the hockey stick would [generate] had little to do with the depicted temperature rise in and of itself. Rather, it was a result of the perceived threat this simple graph represented to those who are opposed to governmental regulations or other social restraints aimed at protecting our environment and the long-term prospects for the health of our planet.[433]

This statement no doubt holds more than a grain of truth, but it also assigns a malicious intent to skeptics across the board that is not likely accurate. In this statement and others like it, Mann seems to suggest that ideological predispositions influence the scientific reasoning and conclusions of skeptics, but that scientists like him who stand with the consensus are not also ideological creatures—or at least are able to leave their ideology at the door when they enter the lab. The abstract ideal of scientists conducting their research devoid of ideology, however, is naïve impossibility.[434]

Although to say that a scientist is influenced by their ideology is an insult according to the assumed model of the scientific production of knowledge,[435] this acknowledgement that science is never truly devoid of ideology should not be taken as a reason to dismiss scientific findings, but rather a call to simply acknowledge that no knowledge is absolutely certain, and that acknowledging and seeking out the background assumptions of research strengthens its empirical foundation. Furthermore, research in political psychology concludes that the phenomenon of ideological predisposition influencing whether scientific research findings are

[433] Ibid: xvi.
[434] Helen Longino, "Science as Social Knowledge: Values and Objectivity in Scientific Inquiry," *Princeton University Press* (1990). See also: Daston.
[435] See discussion of science/politics in chapter one.

accepted or rejected is widespread.[436] Therefore, the "fault" that Mann accuses skeptics of possessing- a lack of separation between one's ideological predispositions and scientific reasoning- is no doubt one he shares with them (and *all* scientists).

Moreover, it is also likely that many skeptics are heartfelt in their sentiment that the scientific consensus is incorrect.[437] There is a portion of the skeptic movement that, evidence suggests, is indeed following a quite conscious and even malicious strategy of doubt mongering in direct support of moneyed interests.[438] This description does not fit all of them, just as climate activists often believe in the cause with little grasp of climate science as well.[439] In other words ideology can be a stronger motivator of activism than is the science itself. A belief in the value of "science" is widespread, but what meets individuals' criteria for "science" is influenced by these ideological predispositions. In sum, Mann paints too simple a picture of the skeptic camp, neglecting to consider, for example, that the perception of increased governmental regulation for the sake of the environment is genuinely perceived as a dire threat to free will by some, just as Mann genuinely perceives that "social restraints" for protecting the global environment are a matter of necessity.[440]

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[436] Anabela Carvalho, "Ideological Cultures and Media Discourses on Scientific Knowledge: Re-Reading News on Climate Change," *Public Understanding of Science* 16, no. 2 (2007).
[437] For example, see the discussion of the differences between different types of meteorologists in chapter four.
[438] This is promoted by an organized campaign that follows a model of political strategy of fostering scientific doubt that has been used by the tobacco industry and others: Naomi Oreskes and Eric M. Conway, *Merchants of Doubt...* (Bloomsbury Press, 2010).
[439] Christopher P. Borick and Barry G. Rabe, "A Reason to Believe: Examining the Factors That Determine Individual Views on Global Warming*," *Social Science Quarterly* 91, no. 3 (2010).
[440] This tension between necessity and free will, as applies to climate, will be explored in the next chapter.

Often, climate contrarians are accused of being "anti-science."[441] For example, Clive Hamilton (a prominent public ethicist, especially in the Australian public discourse on climate change), writing after the 400ppm threshold had just been crossed, states "[i]f you are not frightened by this fact, then you are ignoring or denying science."[442] While denialists' scientific reasoning would typically not pass muster with respected scientific organizations (though there are some interesting quasi-exceptions[443]), the contrarians typically do appear to have faith in the scientific method and scientific reasoning in an ideal, abstracted, sense. This is evidenced in the allusions to rationality (comments 1, 4 & 5) and "real" science (comments 2 & 3), excerpted from online comments previously on pages 188-189). It is the findings and institutions of mainstream climate science in particular that they are skeptical of.

The response of the climate science consensus and skeptics to one another is much more than an empirical dispute; rather, it is a political dispute that takes place by deploying truth-based claims. The consensus scientists impugn the trustworthiness of denialists by accusing them of being anti-science. The denialist strategy of casting doubt on the anthropogenic basis of climate change is telling a causal story that places climate change outside of the realm of will and intent, and in so doing makes the case

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[441] This "anti-science" accusation is not limited to climate science, and is often framed as part of a larger "culture war," waged frequently through debates such as creationism v. evolution. For example, see: C. Mooney, The Republican War on Science (New York: Basic Books, 2005). Another example of this sentiment is captured in this editorial: Adam Frank, "Welcome to the Age of Denial," *The New York Times*, August 22 2013. http://www.nytimes.com/2013/08/22/opinion/welcome-to-the-age-of-denial.html?_r=0

[442] Clive Hamilton, "Geoengineering: Our Last Hope, or a False Promise?," ibid., May 26. http://www.nytimes.com/2013/05/27/opinion/geoengineering-our-last-hope-or-a-false-promise.html?emc=tnt&tntemail0=y&_r=0

[443] For example, see the discussion of the BEST lab in the next chapter.

that nothing could or should be done. The disagreement is not merely one of empirics, and will not be resolved on empirical grounds alone. This raises questions as to the strategic value of emphasizing “reality” for climate activism.[444]

The ostensible simplicity of “carbon” does not resolve this struggle over problem definition. Climate contrarians and the climate movement invoke “carbon” quite differently, and both claim that their side’s representation of “carbon” illustrates the more accurate understanding of the climate system and the degree of influence of humans within it. For example, in response to the crossing of the 400ppm marker, skeptics claimed that this was “undramatic,” with carbon dioxide comprising only 0.04 percent of the atmosphere, whereas climate activists called it a “milestone,” pointing to the scientific consensus that carbon dioxide concentrations at that level will have a significant warming effect on the planet.[445] Both of these descriptions of “carbon” are correct in a technical sense. The contention is not, however, driven by a technical dispute. Rather, underlying metaphysical differences and questions regarding the nature of “reality” enliven the technical quibbles.

Social Impediments to a Technological Fix

> *Germany is one of the only big countries that has actually tried hard to change its energy mix; on one sunny Saturday in late May, that northern – latitude nation generated nearly half its power from solar panels within its borders. That’s a small miracle—and it demonstrates that we have the technology to solve our problems. But we lack the will. So far, Germany’s the exception; the rule is ever more carbon.* [446]

[444] This issue is taken up in chapter four.
[445] Gillis.
[446] Bill McKibbon, "Global Warming’s Terrifying New Math: Three Simple Numbers That Add up to Global Catastrophe - and That Make Clear Who the Real Enermy Is," *Rolling*

Often, acknowledgment of the failure of climate politics is accompanied by lamentations that the problem continues, not due to a lack of technological capacity, but a lack of social capacity to develop and disseminate the technologies that (it is presumed) would remediate climate change. The Breakthrough Institute's advocacy of ecological modernization is an exemplar of this logic.[447] In short, explanations of the failure of climate politics that stress that there is a technical fix to the problem place blame for the failure of climate politics with "social" factors. This perspective relies on an abstract notion of division between society and technology, an oversimplification that has consequences that are likely to disappoint climate activism when applied to the problem of climate change. What gets lost in this explanation is that technology does not exist "outside" the social world. By overlooking the significance of socio-technical systems,[448] explanations of this type naively espouse technology in one breath and disparage social "impediments" to realizing technological promises with the next. Technological optimism is counterbalanced with social pessimism.

Although these explanations may acknowledge, to an extent, the overlay of social and technical, on the whole they nonetheless espouse the problem as a social one and the solution as a technical or technological one. Gary Dirks, director of Lightworks and the Global Institute of Sustainability (both affiliated with Arizona State University), and a former president of BP Asia-Pacific and BP China, has

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Stone, July 19 2012. http://www.rollingstone.com/politics/news/global-warmings-terrifying-new-math-20120719

[447] See discussion at the end of chapter one.

[448] Again, see discussion at the end of chapter one.

forwarded that the answer to the climate problem is “subtle and sophisticated public policy.”[449] He names support for developing plug-in hybrids and aggressive CAFE standards (which require automotive retailers in the United States to increase the average efficiency of their future fleet sales) as two examples of the types of policies he means, at least in countries whose infrastructures are already tightly enmeshed with automotive technology.

Dirks also argues that “developing countries need… to develop an entirely new social structure,” especially aimed at discouraging the development of “auto society in the developing world.”[450] In this explanation, it is the failure of world leaders’ to create incentives that would encourage the right kind of “low carbon” technological development, and their failure to create social policies that would lead to following the correct technological path, that is used to explain the failures of climate politics. Dirks also expresses hope that President Obama not approve the Keystone pipeline (his wish was granted), as a way to put pressure on large MNCs that could divert them into thinking about “better things than Canadian tar sands,” such as “getting Exxon to put more engineering resources into non fossil sources of carbon.” In this case, it is a question of social structures having the wisdom to support the right technologies and discourage the wrong ones. In short, for Dirks, the

[449] Dirks, Gary. Presentation and discussion at the National Institute for Energy Ethics and Society at Arizona State University, April 10, 2013.
[450] In India, plentiful traffic jams and automotive pollution indicate that automotive society has already taken hold to some extent, and in response to the traffic and pollution some measures to discourage it have followed: Jason Burke, "India Introduces Car Sales Tax to Combat Pollution," *The Guardian*, February 29 2016.
https://www.theguardian.com/world/2016/feb/29/india-introduces-car-sales-tax-to-combat-pollution

trouble is with policy that fails to support the necessary technological advances. Dirks' proposition that different policies could lead to more efficient development (in reductive "carbon" terms) is not in doubt, though the extent to which these technological fixes would amount to a solution, and whether these are the "correct" policies for society is another matter.

According to the technology explanation for the failure of climate politics, using "carbon" to compare various technologies is how one knows which technological changes need to be made and the relative promise or danger different technologies pose. For instance, a NPR story reports that research into making fuel from raw plant material creates "cleaner fuels" that "would help reduce the buildup of carbon dioxide in the air, at least a bit. But ultimately, the challenge of reducing global emissions has to be met on many fronts."[451] In this story's analysis, research into cleaner fuels (in this case, genetically engineering microorganisms to create synthetic fuels when feeding on plant material) is worthwhile because of its potential to produce more energy with less "carbon," but is not the most important "lever" in the arsenal. The most important technological lever, according to the director of an engineering firm interviewed for the story, is the efficiency of vehicles. The director quickly points out that "[t]he other big lever is that none of this [large-scale vehicle efficiency gains] happens unless the nation has the will to decide that this is the thing they want to achieve, almost more importantly than anything else." The reporter

[451] Richard Harris, "Put Down Oil Drill, Pick up the Test Tube: Making Fuel from Yeast," (Morning Edition: NPR, 2013). http://www.npr.org/2013/06/28/188431312/put-down-oil-drill-pick-up-the-test-tube-making-fuel-from-yeast?sc=17&f=1001

explains that this means “Americans and others would need to accept fuels that cost more at the pump… [a]nd governments would have to institute that not very popular idea.” This is a typical perspective of the technology explanation (with components of the human intentions explanation as well). In it, the appropriate technological measures are being blocked by the imprudent social sphere. In this explanation, “carbon” is what tells us that the social course that is being taken is unwise and obstructive, and “carbon” is what tells us that technology offers an answer that society should follow.

In some variants of the technology explanation, the solutions that are interpreted as being blocked are more technical than technological. In other variants, specific sources of the social root of the blockage are given. Both of these variations are present in a New York Times editorial, “A Carbon Trading System Worth Saving.”[452] The editorial laments the monumental drop in carbon prices in the European Union’s carbon market (a lower price does not provide emitters the added incentive to invest in cleaner practices as the system intends, and also gives onlookers to the EU trading system reason to question the wisdom of creating other carbon trading systems elsewhere). The editorial board is clearly worried a failure of this “pioneer in tackling climate change” will be an enormous setback to the quest for remediation writ large. The piece specifies two, connected types of reasons for the price drop in the market: technical and social, the latter accounting for the former. It lays blame with European governments that “miscalculated how many [permits]

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[452] Editorial Board, "A Carbon Trading System Worth Saving," *The New York Times*, May 6 2013. http://www.nytimes.com/2013/05/07/opinion/europes-carbon-trading-system.html

would be needed to achieve their goals," and so issued too many. This is depicted as a technical error, the type of error that was again repeated when the EU did not adjust the system's cap in order to raise the price in response to the lower levels of emissions due to recession. The impediment to following these, "correct" (as the article implies) technical measures is the fault of "Europe's leaders," who need to "find the ingenuity to strengthen [the market] and the political courage to weather the criticism that could result from higher electricity prices." Again, the means to fix the problem are assumed to exist (in this case technical adjustments to manage the market that must be taken in order to incentivize the technology), only to be blocked by social factors – leaders who are too responsive to their electorates and insufficiently attentive to market optimization. It is assumed that the (technical) way is there, but it is up to the (social) will to seize it.

The case of the "smart grid" illustrates the faultiness of separating social and technical. The smart grid is, in a sense, an attempt to better manage unruly humans within a technical system, the electric grid, through an additional technical system, a "smart" grid that, rather than taking what humans give to it, is able to recommend to the humans that they modify their behavior (e.g. by running the dishwasher at a different time or turning down the air conditioner). The smart grid, however, also demonstrates that technical systems are never purely technical. Social acceptance of the smart grid and compliance with its recommendations depends on the people in the buildings attached to it being willing and able to do so.

One way of viewing Smart Grids is as a technical system that may or may not work, depending on whether humans change their actions in response—i.e. the technical solution succeeds or fails to fix the social, which has been predefined as problematic, according to the reductive logic of CARBON. Another way to view "Smart" technology, however, is as a socio-technical apparatus of climate governmentality, in which home-based monitors "[serve] to further an individualized and monetized understanding of climate change."[453] Hargreaves finds, through interviewing individuals who participated in a trial run of smart energy monitors in their homes in England, that the devices were frequently resisted, for different reasons that were particular to the dynamics of each home. The devices also layered on top of extant power and relational dynamics within the home. The monitors, overwhelmingly, were used by a single-household member, predominantly the oldest male. Most commonly, that member would attempt to sway behaviors of others in the house, and were often met with resistance, such as another member valuing the quality of light from an incandescent bulb over more energy efficient ones.[454] This can be read as an instance of CARBON encouraging valuation of energy efficiency over aesthetic value (indeed, CARBON does not recognize aesthetic value at all), but meeting with resistance. Overall, "the monitors were simply ignored in areas of

[453] Tom Hargreaves, "Smart Meters and the Governance of Energy Use in the Household," in *Stripple, J. And H. Bulkeley (2013). Governing the Climate: New Approaches to Rationality, Power and Politics, Cambridge University Press.*133.
[454] Ibid. 135.

practice where they appeared to threaten cherished ethics and aesthetics of the home."[455]

Technological development does not occur in an asocial bubble. The use of particular technologies influences the types of technologies that come to be demanded and supported down the line. For example, when transportation occurs largely by automobile during a period of rapid development in a metropolitan area, the transportation infrastructure that the area develops becomes auto-centric, making cars into necessities for most residents, as was the case in Los Angeles and Phoenix. These cities have sprawl that follows highways, whereas older cities are typically easier to navigate with public transportation or on foot. Boston, for instance, developed around multiple town squares, with diagonal lines running between. This process is on-going. Today, when light-rail lines are built, apartment buildings pop-up alongside, as is true of Denver.

Likewise, there is little use in envisioning an "ideal" electricity infrastructure, built from the ground up. In the United States, three basically separate grids already exist (for the most part they are divided between the West, Texas, and the East and some of Canada). Furthermore, electricity must be paid for, and systems of ownership and distribution are tied to the physical technology itself. In the United States, most electricity is produced by distributed through regulated monopolies, with some public ownership as well. In Europe, by contrast, electricity companies are largely in market competition with one another. Advocacy for dissemination of

[455] Ibid. 138.

greener technologies without attention to social considerations, not merely quantitative measurements of "carbon" saved, are naïve. Advocates of technological fixes to climate change often present their arguments as one of a choice between "dirty" and "clean" technologies, but this is a misleading frame that is removed from the reality that current sources and systems of distribution of energy are intricately embedded in daily life around the world. For instance, in Arizona, wealthy people have greater access to rooftop solar and the consumer cost-savings it can provide, while poorer people are in effect subsidizing the current socio-technical arrangement.[456] A gas well that is pumping today is not likely to be knocked down and replaced by a windmill tomorrow.

As Miller notes, energy choices are not between solar, wind and gas, but rather they are between different socio-technical systems.[457] Therefore, the question is not so much whether, but how solar will be distributed. Currently, there is competition between distributed consumer solar leasing and ownership, and large-scale, intensive solar installations, which are maintained by the utilities themselves. The latter makes it easier for grid owners to manage loads, but can have other costs like high water usage and habitat destruction in sensitive desert ecosystems. The former offers some of the security benefits of decentralization, as well as holding some democratic appeal in bringing many people closer and thus more aware of their place in the energy system, but its decentralization and unpredictability (e.g. changing cloud coverage will suddenly take some units online and some units offline) make it

[456] Miller, Richter, and O'Leary. 34.
[71]Miller, Iles, and Jones. 135-148.

more difficult to predict and manage the balance between how much current is coming into and going out of the system. The social impediments to a technical fix frame makes it more difficult to see socio-technical systems, instead encouraging couter-productive thinking that tends to emphasize a view of social and technical systems as separate.

One class of technological solutions, geoengineering, [458] is received somewhat differently than others. Curiously, whereas it is typically assumed in this class of explanations that technological solutions could solve the problem if only society would stop obstructing their deployment, in the case of geoengineering, there is concern that these technologies do not face sufficient socially-based restrictions to keep them from being unwisely deployed. This concern is based in widespread skepticism of the ability of geoengieered solutions to actually solve the problem without creating other, potentially worse, environmental problems.[459] This worry that there are too few social impediments to the deployment of the (geoengineering)

[458] This term is imprecise, and in theory could include just about any technical measure designed to influence the climate, e.g. painting one's roof white. Colloquially, "geoengineering" evokes more controversial projects, e.g. stratospheric aerosol injection (into the atmosphere in order to reflect more radiation into space). Although various geoengineering scenarios relating to matters besides climate change mitigation have been conceived (e.g. "nuclear winter"), but are now, frequently discussed primarily as proposed responses to the global warming problem. These tend to invite accusations of humans "playing god." This criticism points toward the difficulty of distinguishing between nature/man/God in agential attribution, the significance of which for climate politics is taken up in chapter four.

[459] For example, it is hypothesized that ocean fertilization (in which iron is dumped to create more phytoplankton, which sequester CO2) might lead to eutrophication and oxygen dead zones and that, down the line, it could lead to the release of methane. This and many other examples are given in: Wil CG Burns and Andrew L Strauss, *Climate Change Geoengineering: Philosophical Perspectives, Legal Issues, and Governance Frameworks* (Cambridge University Press, 2013).

technology, is practically the opposite of mainstream explanations of the shortcomings of climate politics. Technologies that do not stray from the more customary technological path, such as those that increase the efficiency of products and services that are already economic fixtures (i.e. ecological modernization), are typically not given the geoengineering label or met with the controversy commonly attached to it—rather, they tend to be warmly received.

On the one hand, there is concern that a rogue actor, be it a lone nation state or "a billionaire with a messiah complex,"[460] might unilaterally undertake any number of geoengineering projects. On the other hand, there is worry that political interests will stand in the way of designing a cap and trade system (or carbon tax, etc.) that is powerful enough to cause significant change to existing incentive structures. Programs like cap and trade, which are intended to incentivize the use of more efficient technologies that emit "less" C_{GHG}, require much more involvement in the "social" arena through government "intervention," regulation or subsidization. In other words, although carrying out geoengineering projects potentially involves minimal social tinkering (making these some of the closest to a pure technological fix out of all the proposed technological fixes), faith in this technology is not widespread (although there is a small and vocal contingent of devotees who regard it as something akin to panacea).[461] The intense association of "carbon" with *warming* also

[460] Hamilton.
[461] Talk of geoengineering is typically presented as an "all or nothing dichotomy" in which "either we do it full scale, or we don't do it at all": Thomas Homer-Dixon and David Keith, "Blocking the Sky to Save the Earth," *The New York Times*, September 19 2008. http://www.nytimes.com/2008/09/20/opinion/20homerdixon.html

likely contributes to a narrowed vision of the goals of geoengineering projects. For example, one model of geoengineering through sulfates predicts a cooler world, but drastically different weather patterns as well.[462]

Geoengineering illustrates some reasons to question the technology explanation, and points to how the climate problem and potential solutions to it are typically defined by CARBON. CARBON seems to invite proposals for technical fixes. At the same time, it does not resolve the "correct" technological path—and by extension, the correct social action that would pave the way for that technology, as questions necessarily arise about the winners and losers of any given "fix." There is no way to know that a technological fix does exist, only arguments that a technological fix is indeed a fix. Many geoengineering projects go directly to the source that has been identified as the problem: "carbon" (as opposed to more indirect mechanisms that would raise the price of using "carbon" intensive technologies). Nevertheless, according to the social impediments to technology explanation, agency is "properly" exercised by following knowledge (reminiscent of the second assumption of CARBON), and "carbon" calculation becomes the dictator of this knowledge.

Faulty Incentive Structures

This class of explanation emphasizes that the sources of the climate problem are fundamentally dispersed (e.g. located in the behavior of individuals or individual

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[462] Alan Robock, "Stratospheric Aerosol Geoengineering," *Geoengineering of the Climate System* 38 (2014).

nation states); so solutions (which may be channeled through a more centralized body such as the United Nations or a national governmental policy) must reach these widely distributed sources by modifying the incentive structures (i.e. political economy) in which they operate. There is an emphasis on the way these dispersed interactions take place through everyday activity – activities that are or could be registered in the market and that in turn are responses to the market. Even though agency flows through "interventions" into the functioning of the market –e.g. "correcting" carbon prices—the notion of agency is nonetheless seen as widely dispersed and not centralized—centralized alterations simply provide structural modifications that do not command agency, but rather to which agency responds.

The action that needs to be taken is collectively *en masse* in this explanation, and this alteration of collective behavior may result from new policies that are themselves apt to be seen as a response to dispersed agency, e.g. responses to democratic pressures from below. Explanations of the failure of climate politics that blame faulty incentive structures come in multiple forms, which vary according to both the scale of the action, and the mechanism of participation. The scale of the action or the actor in question may vary from the level of the individual person to that of the nation state. The mechanisms of action may vary, but most obviously include voting (whether it be at an individual's polling place or in the United Nations General Assembly) and economic activity. The atomistic logic underlying these mechanisms of action corresponds to the reductive logic of CARBON (recall its first assumption). Accordingly, explanations of the inadequacies of climate politics that emphasize incentive structures tend to propose solutions that are perhaps the most directly reliant on "carbon."

Take, for example, arguments in favor of a carbon tax. Economists describe how taxing carbon (for example, by placing taxes on energy sources in proportion to the carbon intensity of various sources, such as gasoline and coal) would cause the price of more "carbon " intensive goods and services to rise, encouraging consumers to be "more efficient." In other words, coupling "carbon" directly to the economic incentives of the price-mechanism would motivate behavioral changes of individuals, businesses, and governmental agencies across an economy on the basis of "self-interest" (i.e. maximizing profit or utility), but collectively have the effect of shifting toward a "low carbon economy."[463]

This simple logic is appealing, but in practice these reductive (in both the sense of reducing "carbon" and taking a simplistic approach to political economy) carbon taxation schemes, or similar market-based programs that raise "the price of carbon," get quite quickly complicated when they meet with the "real world." The issue of carbon leakage serves as one example. When one state enacts a stricter climate policy that reduces its "carbon" emissions, there can be economic effects that lead to increases in "carbon" emissions in another—carbon leakage. For example, market based climate policies that cause a "carbon" intensive good to be more expensive in country A not only reduce demand for that good in country A, but in so doing increase the supply and decrease the price of the good in global or regional

[463] See discussion in chapter one.

markets that have not enacted the same “carbon” penalty on the good. This price shift creates the incentive to purchase more of the good in country B, partially cancelling (the exact amount depending on the elasticities of supply and demand) the effect of the climate policy in country A for global “carbon.” A similar negating effect can occur when the climate policy of country A raises the costs of producing a “carbon” intensive good, and so the good’s production is shifted to country B.

Appraising where carbon leakage is or is not likely to occur in response to extant and potential climate policies is a tricky task. The language in a report, “An Empirical Assessment of Carbon Leakage in Poland” serves as an example.[464] This report repeatedly stresses the importance of developing a “harmonized” EU climate policy and addressing “indirect carbon costs” in “a harmonized way” in order to bring Poland on board with EU climate goals. This call for harmonization serves to illustrate the difficulty of bringing so many moving parts together without prompting a string of unintended consequences.

In other words, the incentive structures of global market capitalism are a perpetual constraint on the effectiveness of climate mitigation attempts. Whether capitalism is understood as natural or controllable (reminiscent of the discussion of the issue of anthropogenesis in this chapter’s introduction), therefore, is perhaps as important (if not more) than the causal stories that define the climate problem. The

[464] IDDRI (Institut du développement durable et des relations internationales), "An Empirical Assessment of the Risk of Carbon Leakage in Poland," (http://www.iddri.org/Publications/Collections/Idees-pour-le-debat/WP0813_OS%20TS_carbon%20leakage%20poland.pdf2013).

naturalization of capitalism,[465] in a sense, takes human action out of the realm of human agency, even though, ironically, it also places agency's locus with the human individual. The combined effect is that capitalism becomes understood both as a space closed to human intervention (i.e. capitalism itself cannot be challenged), and as a fundamental space for human intervention in the climate (i.e. humans can make adjustments and interventions *within* capitalist modes of governance). This suggests the potential of *denaturalizing capitalism* as a counter-discourse to CARBON. This approach contends better with the radical nature of the problem, as opposed to the incremental tactics that seem to follow from the current state of CARBON based climate politics. Whereas CARBON is easily taken to suggest that the market is the natural solution to the climate problem, the counter-discourse of denaturalizing capitalism would frame capitalism as the basis of the (no longer natural) *social* problem of climate change. In other words, whether and to what extent capitalism is seen as something that can be controlled by humans is crucial to how the climate issue is understood.

Although capitalism is often blamed for anthropogenic climate change,[466] the dominant discourse of climate politics is a CARBON based one that enables marketized approaches to the climate problem. No doubt, one reason that mainstream

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[465] The naturalization of capitalism (through devices such as the notion of "self-interest") serves to obscure that capitalism is a historically specific form of social organization that, unlike its predecessors, makes economic actors dependent on the market for the necessities of life, therefore requiring competitive behavior of them. A thorough exegesis of this point is provided in: Ellen Meiksins Wood, *The Origin of Capitalism: A Longer View* (Verso, 2002).
[466] For a scholarly example, see: John Bellamy Foster, Brett Clark, and Richard York, *The Ecological Rift: Capitalism's War on the Earth* (NYU Press, 2011).

climate activism has taken the CARBON route instead of more stridently targeting capitalism (or, relatedly, globalization), is that capitalism poses many of the same political difficulties of climate change: responsibility is diffuse, and complexity makes it further akin to "natural" problems that seem relegated to realm of fate rather than subject to human agency. Therefore, a discourse denaturalizing capitalism emphasizes the extent to which markets can be/are controlled by social forces, and that society need not be "embedded" within markets.[467]

The seeds of a counter-discourse (to CARBON) grounded in the denaturalization of capitalism have been planted; however, these seeds largely play into the dominance of CARBON discourse, rather than challenging it. As a counter-discourse, therefore, it is not fully fledged. Naomi Klein's popular book, *This Changes Everything: Capitalism vs. the climate*[468] serves as an example. Klein contends "the triumph of market logic, with its ethos of domination and fierce competition, is paralyzing almost all serious efforts to respond to climate change."[469] Therefore, to "shift the cultural context" would make room for "sensible reformist polities that will at least get the atmospheric carbon numbers moving in the right direction."[470] Environmental/climate activism largely takes a different tack that does

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[467] Polanyi's account of the transition from feudalism to capitalism in England depicts the character of the shift as moving from economic relations that were embedded in social relations, to a disembedding of the market from society, making markets a potent force governing social relations: Karl Polanyi, *The Great Transformation: The Political and Economic Origins of Our Time*, ed. 11th (Boston: Beacon Press, 1944 (1957)).
[468] Klein.
[469] Ibid. 23.
[470] Ibid. 26.

not place capitalism in the crosshairs.[471] As Klein describes, " large parts of the climate movement wasted precious decades attempting to make the square peg of the climate crisis fit into the round hold of deregulated capitalism."[472] Klein's denunciation of a capitalist system governed by elites who are invested in its continuation is slightly out-of-sync with the technocratic character of many of her proposed solutions; e.g she echoes calls of the Bolivian WTO ambassador for a "Marshall Plan for the earth,"[473] and has ecomodernist faith in the growing efficiency and cost effectiveness of renewables.[474] Allured by CARBON, she touts the "small pockets" where "low carbon lifestyles" have met with "tremendous success."[475] Put differently, Klein often reaffirms many of the modernist assumptions embedded in CARBON. In short, Klein's challenge to capitalism is not a challenge to the CARBON discourse that so-often facilitates climate "action" that works with the capitalist status quo.

A number of classic concepts in political science share the self-interested, individualist orientation of naturalized capitalism and demonstrate the type of logic endemic to faulty incentive structure explanations. For example, descriptions of climate politics as a "collective action problem" emphasize that the problem is caused by the uncoordinated pursuit of individual benefit in the short-term (e.g. the widely

[471] An anecdotal example: a Greenpeace activist, soliciting outside of a Whole Foods Market, once attempted to get me to sign a petition related to nuclear power. I suggested that the group could benefit the environment more if it worked on campaign finance reform. A heated discussion ensued.
[472] Klein. 20.
[473] Ibid. 5.
[474] Ibid. 16.
[475] Ibid. 16.

distributed sources of "carbon" emissions), which causes greater difficulties in the long-term (i.e. climate change and its effects) both for the individuals who originally benefited, and collectively.[476]

The solution, it is assumed, is for an authority to impose regulations to halt the problem (e.g. the U.N. mediates a treaty mandating significant global "carbon" reductions), as a sufficient quantity of individuals will not voluntarily cooperate, knowing that they stand to lose while others free-ride off of their actions. (E.g. an administration arguing that it cannot subject itself to the diminished economic growth that would follow implementation of national "carbon" reductions, while its economic competitor continues to grow its economy and "carbon" emissions).[477] The collective action frame is not inaccurate, but it does tend to overshadow other understandings of the problem. Working from a "carbon" based problem definition, the solution that follows is also "carbon" based, making it more difficult to conceive of plans that are not the same. The same can be said of the Tragedy of the Commons frame below.

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[476] Empirical observations of many instances of common pool resource problems, however, find that cooperation in the face of collective action dilemmas is not uncommon, as well as instances in which external authority has worsened rather than alleviating problemsAmy R Poteete, Marco A Janssen, and Elinor Ostrom, *Working Together: Collective Action, the Commons, and Multiple Methods in Practice* (Princeton University Press, 2010).
[477] That global warming constitutes a collective action problem is, however, debatable. Bond, for instance, contends that climate change is not clearly a collective action problem, because the burden of impacts is vastly unequal, affecting the poor and unborn the most: Patrick Bond, "From Copenhagen to Cancún to Durban: Moving Deckchairs on the Climate Titanic," *Capitalism Nature Socialism* 22, no. 2 (2011).

Providing another canonical example, Hardin's "Tragedy of the Commons"[478] uses the metaphor of a number of herders sharing a common field. Each individual herder has an incentive to graze additional animals on the commons in order to create more products (e.g. milk). The result is the grazing of more animals than the land can sustain, and the tragic result is a commons ruined for everyone. Hardin was making a larger argument about human population and the earth's carrying capacity, has been frequently drawn upon to call for privatization of common resources. This argument—that privatization will save commons resources that would otherwise be endangered by being held in common—follows from an assumption of distributed agency in which individuals are primarily motivated by self(ish)-interest, which must accordingly be channeled through a revision of the incentive structure (private property). This interpretation is an example of the naturalization of capitalism at work, and is historically misleading. The resource scarcity that led English peasants out of the country and, eventually, into the cities to provide labor for the industrial revolution, was caused by the enclosure of communal land, not depletion from overuse by peasants.[479] There are countless examples of the privatization of common land that had previously been well managed by self-governing communities, but that, after privatization, were decimated.[480] Nevertheless, many proposed solutions to climate change rely on the metaphor of the "atmospheric commons" to argue for

[478] Garrett Hardin, "The Tragedy of the Commons: The Population Problem Has No Technical Solution; It Requires a Fundamental Extension in Morality," *Science* 162, no. 3859 (1968).
[479] George Monbiot, "The Tragedy of Enclosure," *Scientific American* 270, no. 1 (1994). 159.
[480] Ibid.

privatization of the right to pollute, e.g. through cap and trade systems that issue carbon credits.

Among the climate concerned, the divergence of opinions regarding Carbon Capture and Sequestration (CCS) is an example of explanations of climate politics' failure that lean heavily on the idea of faulty incentive structures – in particular that action is structured by a price mechanism that improperly values "carbon." Howard Herzog, who heads MIT's Carbon Capture and Sequestration Technologies program, claims that getting industrial scale CCS projects underway is essential to solving the climate problem (more precisely, he sees either large-scale CCS or greatly increased nuclear energy production as necessary to addressing the climate problem on a sufficiently large scale). Herzog argues CCS is being blocked, most basically, by the incentives that follow from the price of emitting "carbon," which "for all practical purposes, is zero."[481] Leading figurehead of the climate movement Bill McKibben contends that CCS is utterly economically impractical (much like Herzog), but that "[e]ven if you could do [CCS] there's no getting away from the fact that we have to reduce emissions dramatically […] we have to get off fossil fuels fast and the only real way to do that is to put a serious price on carbon. It's always been the only real show in town."[482] McKibben and Herzog are both on a quest to fix the climate

[481] Quoted in: Tom Zeller Jr., "Carbon Capture and Storage: Global Warming Panacea, or Fossil Fuel Pipe Dream?," http://www.huffingtonpost.com/2013/08/19/carbon-capture-and-storage_n_3745522.html.

[482] Leo Hickman, "Bill Mckibben on Tar Sands, Obama, Geoengineering and Population Growth," *The Guardian Blog*, October 6 2011. http://www.theguardian.com/environment/blog/2011/oct/06/bill-mckibben-keystone-pipeline-oil

problem, and both view "incorrect" market carbon prices as the primary impediment to the types of actions that are necessary to tackle the problem, but their respective "carbon" calculations also lead them to divergent appraisals of the promise of CCS technology. Nonetheless, the view in both cases is that the incentive *structure* is seen as out-of-sync with the climatic requirement of "carbon" reduction.

While the examples of "carbon" valuation mentioned above are pointing to the most basic and dispersed element of the faulty incentive structures, others describe the widely distributed nature of the problem in terms that emphasize a structural failure as a lack of strong central authority. For example, Biermann et al,[483] writing in *Science Magazine,* argue that "structural change in global governance is needed" to "bring about societal change at the level and with the speed needed to mitigate and adapt to Earth system transformation."[484] In essence, they blame the weakness of institutions of global environmental governance for the "incremental change" that has been insufficient for addressing global environmental problems to this point, and argue that the issue has now become so urgent that more dramatic, "structural" changes have become necessary.

By structural change, Biermann et al mean primarily institutional and organizational change to large-scale governance, especially the United Nations (not

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[483] F. Biermann et al., "Navigating the Anthropocene: Improving Earth System Governance," *Science Magazine*, March 16 2012.
[484] This article refers to climate change obliquely, subsuming it under the rubric of the "anthropocene." Nonetheless, climate change looms large as a prime concern, through references to "tipping points," "irreversible change" and "global emissions markets." The article's exclusion of direct references to or an explicit focus on climate change is a novelty and curiosity.

the structure of a capitalist and neo-liberal world order that is pointed to in some counter-discourses to CARBON). For example, they advocate "upgrading" the UN Environment Programme to an agency with status on par with the World Health Organization. While they acknowledge that changes to the structure of the intergovernmental system are not the only level at which change will occur, they privilege it, stating that "in order for local and national action to be effective, the global institutional framework must be supportive and well designed."[485] The short article does not mention any obstacles that would explain why the more effective environmental governance framework they propose has not come into being, nor the challenges of doing so, other than a vague reference to the question of "whether political will exists to bring about these urgently needed changes."[486] Although this is an explanation of failure that points to many structural constraints, its reference to "political will" in its closing statement, also paints the problem as one of agency, albeit an amorphous conception thereof. The explanation portrays this as an agency problem, even while expressing some uncertainty that said agency exists.

The Elephant: Perhaps Climate Change is not Solvable

> *If you're looking to stave off climate perturbations that I don't believe our culture is ready to adapt to, then significant reductions in CO2 emissions have to occur right away… I feel like the time to do something was yesterday.*
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> Mark Pagani, geochemist, Yale University[487]

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[485] Ibid. 1307.
[486] Ibid. 1307.
[487] Gillis.

Pagani's statement demonstrates the conflicted position of climate activism. While on the one hand it stresses an imperative for action *now,* on the other hand there is a fear that *now* is already too late. Many pleas for "action now" are *now* in the past. Given the level of urgency with which they were delivered and the level of inaction with which they were met at the time, it is not unreasonable to consider the implication that responses in the current "now" are, quite possibly, too late. Calls for the "now" imperative go back and have been intensifying for decades: but "now" did not happen. Climate activists, however, tend toward a perpetual extension of the horizon of "now." One interpretation of this logical inconsistency is that the possibility that the climate problem will not (and perhaps even cannot) be fixed is lodged in the collective subconscious of climate activism. Implicit within this possibility is a disheartening explanation for the failure of climate politics: that it continues to fail because the visions of a solution constructed by climate activism, i.e. based on CARBON, are not realistic.

This section explores an explanation for the failure of climate politics that is somewhat in competition with the others. This is the (in many circles) taboo proposition that climate change is not a solvable problem—at least not in the CARBON based way it has been defined. At root, this is a dispute about agency. In other words (and to undertake a monumental simplification), explanations of the failure of climate politics can be compared on a single axis. At one end are those explanations that assume that the failure is due to improper channeling of agency so far, but that the necessary agency does exist. At the other end are those explanations that posit that the problem has not been solved because the requisite agency does not exist within the CARBONIZED problem definition.

This latter possibility, when acknowledged, is often mentioned with some discomfort. "Yes we can," is an effective political slogan (or at least it was for Barack Obama in 2008); "No we can't," is not. It is especially unpopular to make so pessimistic a suggestion in this extreme form. The result is that some observers explicitly tackle the topic of how daunting a task climate change is, but nevertheless do not go so far as to suggest that the problem may be unsolvable according to the terms of CARBON. For example, Levin et al[488] say climate change exemplifies a "super wicked problem." Although they define this term precisely by adding four qualifications for what makes a problem super wicked,[489] the terminology "super wicked problem" conjures a rather dramatic pessimism. This pessimistic tone is further reaffirmed by the authors' determination that when the four factors that comprise super wicked problems are combined, the result is "a policy-making tragedy." Nonetheless, the authors adopt a hopeful stance, arguing that positive policy interventions, designed to be "sticky," can create new path dependencies that can "constrain our future selves" and so make the climate problem surmountable. Levin et al sketch an outline of an elephant but are reticent to acknowledge that it is in the room.

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[488] Kelly Levin et al., "Overcoming the Tragedy of Super Wicked Problems: Constraining Our Future Selves to Ameliorate Global Climate Change," *Policy Sciences* 45 (2012).

[489] The criteria are: that time is running out; those who seek to solve it are also contributors to it; a central authority to address it is lacking; and policy responses to it dramatically discount the future.

Strands of the elephant argument can even be found in the rhetoric of ardent climate activist Bill McKibben: "Since all of us are in some way the beneficiaries of cheap fossil fuel, tackling climate change has been like trying to build a movement against yourself—it's as if the gay rights movement had to be constructed entirely from evangelical preachers, or the abolition movement from slaveholders."[490] Such an appraisal could be reasonably expected to inspire apathy, undercutting McKibben's louder rallying cry for public engagement to fight the fossil fuel industry and keep "carbon" in the ground.[491]

In short, because fixing the climate necessitates enormous changes to how humanity functions, the mission of climate activism is unavoidably radical. This radicalism is incommensurate with reformist proposals that fit well within familiar norms that many activists tout. After all, carbon taxes and cap and trade programs are merely efforts to "correct" markets, and hardly present a challenge to them as a domineering force in organizing socio-natural relations. Many mainstream environmentalist strategies to counter climate change work with a neoliberal model that seeks to enhance the availability of "green" economic choices more so than to reduce consumption. Green consumerism can encourage feelings of environmental action by individuals while having the effect of privatizing and depoliticizing environmental problems (and heightening expectations for women's unpaid

490 McKibbon.

491 McKibben has organized and spoken at many protests against the once-proposed, now-rejected Keystone XL pipeline. His frequently repeated argument against Keystone was that the Canadian tar sands are a dirty (high "carbon" emitting) fuel source that should not be refined and released into the atmosphere, but needs to stay in the ground.

household labor).[492] Environmental groups and fortune 500 companies have partnered together in efforts to curb climate change,[493] but it is difficult to argue that the companies' motives for participation are not greenwashing.[494]

The face of climate activism may, at times, indirectly imply the possibility of ultimate failure, but typically direct mention of that possibility is avoided. When direct mention *is* made, it is likely to be dampened by more hopeful statements about how something might still be able to be done. Often when fingers point at the vastness of the climate problem, the aura of insolvability is fairly well obscured by optimism. For example, Robert Fri, chairman of the American Academy of Arts and Sciences' Alternative Energy Future project, acknowledges that "solving the climate problem requires changing a vast energy infrastructure on a global scale," which is a challenge that "far exceed[s] any other environmental problem we've seen before."[495] Yet, after coming quite close to acknowledging this elephant, he goes on to treat it as somewhat tamable: he recommends the incorporation of more insights from social science into policy-making, e.g. "writing a clear energy-efficiency label," or investing

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[492] Catriona Sandilands, "On" Green" Consumerism: Environmental Privatization and" Family Values"," *Canadian Woman Studies* 13, no. 3 (1993). 45.

[493] The U.S. Climate Action Partnership is the prime example: Steven Mufson, "Coalition Agrees on Emissions Cuts," *The Washington Post*, January 15 2009. http://www.washingtonpost.com/wp-dyn/content/article/2009/01/14/AR2009011403850.html

[494] The Union of Concerned Scientists reports that many of the corporations involved in the aforementioned CAP have invested more resources into efforts to fight climate action: UCC (Union of Concerned Scientists), "A Climate of Corporate Control: How Corporations Have Influenced the U.S. Dialogue on Climate Science and Policy," (http://www.ucsusa.org/sites/default/files/legacy/assets/documents/scientific_integrity/a-climate-of-corporate-control-report.pdf2012).

[495] Quoted in: "Sunday Dialogue: Tackling Global Warming," April 6 2013. http://www.nytimes.com/2013/04/07/opinion/sunday/sunday-dialogue-tackling-global-warming.html?pagewanted=all&_r=0

"in understanding what policies and institutions must come into being to manage the climate problem over the long term."[496] There is, however, a lingering incommensurability between these small, pragmatic recommendations and the vastness of the problem as it has been diagnosed.

The relative weight difference between these components suggests reason for pessimism. Political theory is a realm more amenable than most to straightforwardly acknowledging this glum possibility, and also gives the most food-for-thought as to its implications and significance. Wainright and Mann, geographers writing in *Antipode* (a venue that fits the political theory classification)*,* do so by at first asking what sorts of "massive social reconstruction" might bring about the massive reductions in carbon emissions that are required, and question whether these reductions could "happen in anything resembling a just manner, or in any manner at all?" They go on to state that failure to achieve massive social reconstruction "seems highly likely to us," prompting them to probe the political-economic consequences that would follow the climatic changes, such as hitting an ecological tipping point. They ask:

> once climate change is impossible to ignore or reverse, then what are the likely political-economic outcomes? What processes, strategies, and social formations will emerge and become hegemonic? Can the defining triadic form of the modern world—capital + nation + state…--survive catastrophic climate change?[497]

[496] Ibid.
[497] Wainwright and Mann. 3.

This is reason to return to the basic question of problem definition. If solving the problem requires a massive reorganization of the world we know, then "the world" as we know it cannot solve climate change; therefore, it must become a different world.

The implications are paradoxical. From one perspective, the world fixes the climate, but undoes itself. From another perspective, the climate has forced the world to reconstitute itself. In either case, solving the climate problem cannot fairly be separated from the re/configuration of the socio-natural order. Ostensibly, the difference between the scenarios is a matter of the location of agency. In the first, the world is acting upon the climate. In the second, the climate seems to have the upper hand, and could even be characterized as agential, as it *forces* the world's action—the world acts not out of choice but necessity. There is, however, also a robust lack of difference between the two scenarios. In either case, the world in which climate change is no longer a problem is radically different from the world we currently inhabit.

There are parallels between the elephant explanation of failure and denialism, but there are fundamental differences as well. The largest difference is that, according to denialism, the problem does not exist, whereas, according to the elephant, the problem does exist, but its existence does not guarantee the commensurate existence of a viable solution. This latter point, that problems should not be assumed to have solutions, may seem uncontroversial when stated as such, but in practice it seems that much climate activism is unwilling to acknowledge this possibility. In consideration of the political importance of defining problems through causal stories that identify a target for action, this is not terribly surprising. It is, nevertheless, troubling.

The parallels between the elephant and denialism are likely a reason for the existence of the elephant in the first place. That is, denialism and the elephant are both readily interpreted as obstacles to a solution. The difference is that there is a high correlation between an ideological disposition that is skeptical of environmental regulations and denialism, whereas those that acknowledge the elephant are frequently in favor of substantial and even radical changes for the sake of environmental protection. The question that remains is to what extent acknowledging the elephant in the room might help or hurt the climate cause.

Conclusion: Agency?

With these five explanations now given, it is time to examine them as a whole, and to consider the insights that come from their juxtaposition. First, however, some disclaimers are in order. It should be remembered that these explanations are not mutually exclusive, and are often combined in the same statement. For example, when Tim Lueker, an "oceanographer and carbon cycle researcher" was asked to comment about the significance of the Scripps measurement of atmospheric CO2 at Mauna Loa crossing the 400ppm threshold in the spring of 2013, he said the marker "should serve as a wake up call for all of us to support clean energy technology and reduce emissions of greenhouse gases, before it's too late for our children and grandchildren."[498] By saying "before it's too late," Lueker indicates that climate politics is not on a path toward successfully fighting climate change, and might not find that path—approaching the elephant. The solution he points to is clean energy technology, which he presumes will be built after the support for it has been gained. This suggests a need for technological fixes, and that the misalignment of the beliefs of "all of us" is what stands in the way of enabling this technological fix—i.e. beliefs and intentions matter, and they matter because they can be a social impediment to the necessary technical fix.

Less frequently, rather than the additive effect of combining multiple explanations together to explain the climate quagmire, explanations are put in competition with one another, or reframed in creative manners. For instance, Michael Schellenberger and Ted Nordhaus, heads of the Breakthrough Institute,[499] consider the popular position that a carbon tax is the ultimate fix to the climate problem to be a social impediment to support for the technological innovation that they argue is paramount.[500] This frames the "popularity" of a carbon tax proposal as itself a social impediment to a technological fix, even though it is more customarily regarded as itself a technological fix that faces social impediments to implementation. Clive Hamilton puts explanations in competition when he states that geoengineering is not

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[498] "Climate Scientists' Letter to Resources Minister: 'We Are at a Critical Moment'," *The Globe and Mail*, May 9 2013. http://www.theglobeandmail.com/news/politics/climate-scientists-letter-to-resources-minister-we-are-at-a-critical-moment/article11816560/

[499] They established Breakthrough after the incredible attention that their 2005 article received: Ted Nordhaus and MIchael Schellenberger, "The Death of Environmentalism: Global Warming Politics in a Post-Environmental World," (2004). http://www.thebreakthrough.org/PDF/Death_of_Environmentalism.pdf.

[500] Michael Schellenberger and Ted Nordhaus, "Subsidies for Innovation," *The New York Times*, November 12 2012.

to blame for the failure to solve climate change, but "only highlights our unwillingness to confront the deeper causes of global warming—the power of the fossil-fuel lobby and the reluctance of wealthy consumers to make even small sacrifices."[501] In this instance, this competition is the consequence of Hamilton's strong conviction that the climate problem is, first and foremost a moral one that grows out of "social dysfunction" that is evident in "the power of corporate interests, the fetish for economic growth and the comfortable conservatism of a consumer society" (all of which hinder emissions cuts). Therefore, in his view, geoengineering, as an attempt to remediate climate change without having to correct for moral shortcomings, is seen to exacerbate them. He may see other social "failings," particularly moral ones, as impediments to a technological fix, but not when that fix is geoengineering.

The fundamental issue of agency that has been repeatedly alluded to in this chapter is typically skirted through the assumption that agency can be summoned and directed with the guidance of knowledge. In all of these explanations "carbon" indicates desynchronization between knowledge and action, as well as being believed to be a mechanism for their synchronization. In other words, these constructions of climate change are quintessentially modernist.[502] The relationship of this modern framework to the ontological tensions underpinning climate politics is taken up in the next chapter.

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[501] Hamilton.
[502] See chapter one.

The commonality of "carbon" as both an overt and at times subtler foundation in these conventional explanations underlines a shared principle: that it is typical to talk and think about climate change as tantamount to a numbers problem, something that can be solved via an equation. This hypothetical equation is incredibly elaborate and complex, but guided by one reductionist principle; the quest for the proper configuration of "carbon." Problem definition, however, we should recall, is not an empirical but a political contest; the politically "successful" definition of a problem may turn out to be matched with a proposed policy solution that will not necessarily solve the problem in ecological terms. One implication of this disjuncture is that there is a danger that climate problems and solutions will be estranged, and that policy responses might do little to respond to what turns out to be the "actual" problem. (As chapter two illustrates, CARBON facilitates this distance.) This attention to "carbon" is indicative of an assumption that things identified as problems *have* solutions, and these solutions need simply to be discerned and enacted. There are two difficulties with this notion. One, the processes of discerning and enacting are quite entangled, especially when we acknowledge that engineering is not merely technical but also always social. More importantly – and this is what the elephant in the room points us toward – climate change may not have an equation waiting to be discovered: it may not be an engineering problem.

Finally, we can return to the frame of problem definition and causal stories. The four conventional varieties of explanation follow from the causal story of climate change as a problem for which the human agency to solve it exists and needs only to be properly channeled *vis a vis* “carbon.” The failure of climate politics, in that case, is someone’s fault, and can be corrected. The fifth explanation questions whether the requisite human agency to satisfactorily address global warming *exists*. This fifth explanation emphasizes the unintentional contributions to the problem, and suggests that there are limits to the human ability to guide the forces that perpetuate climate change. One implication of this analysis, then, is that underneath the matter of the failure of climate politics lies a deeper question as to whether or not climate change is even solvable. This question is better reframed as asking whether an *acceptable* solution exists. This issue is taken up in depth in the concluding chapter.

There is an undercurrent of worry that the problem might not be solved—perhaps the right alignment of agency will not come to pass. As one earth scientist, Maureen E. Raymo, stated in response the crossing of the 400ppm threshold, “[i]t feels like the inevitable march toward disaster.”[503] This prompts a question: *has this future been determined*? Or, to borrow Dr. Raymo’s words, *is this future inevitable*? These issues of determinism/contingency, together with the ontological difficulties regarding agency that this chapter raised, will be brought together in the next chapter.

[503] Gillis.

A World of Data and Models of the World

Introduction

The strength of CARBON as the dominant discourse of climate governance makes it difficult to imagine an approach to climate politics not anchored to "carbon." "Carbon" is considered to make up so much of the world (consider "carbon" based life forms), and to determine so much of how change takes place within it (e.g as a primary driver of climate change), and yet we cannot directly observe it through the senses. "Carbon's" evanescent and omnipresent qualities, and its entanglement with agential propositions, puts it in the company of metaphysics. Whereas chapter one gave an account of where "carbon" came from and how CARBON came to discursively embody certain tenets of modernity, this chapter draws connections between "carbon" and older tensions between deterministic and contingent understandings of history, scholastic and nominalist theologies, and universalistic versus particularistic philosophies (all of which echo one another). Exploring "carbon" through this theological binary helps illuminate why it is such a fraught political subject/object; climate change materializes these ontological tensions, both because knowledge of it is an enormous and complex reification of data/models, and because, as a phenomenon, climate change materially forces many of the same metaphysical issues. From this perspective, "carbon" highlights the lack of clarity surrounding the extent to which agency and responsibility rest with humans, as opposed to God and/or nature.

The chapter begins by outlining these metaphysical tensions and the difficulty they bring to agential and causal propositions, and their linkage to questions regarding how to delineate nature/man/God. The next section of the chapter describes how these ontological and epistemological issues underlie contention with regard to climate governance and are invigorated by CARBON. It demonstrates how this deeper source of conflict is captured through a tension between data and models that surfaces repeatedly and pervades different sites in climate politics, and describes how this tension recurs, drawing on examples from the spheres of knowledge production and science, government, and technocratic management. CARBON affirms a simplistic and straight-forward attitude toward the relationship between models and data, when the "reality" is that the relationship is much more complex (a few allusions are made to how this tension surfaces in other areas of science/politics as well). The conclusion summarizes the implication that CARBON makes it more difficult to confront this important aspect of the climate problem.

Metaphysical Carbon

The philosophical epoch that preceded naturalism (see chapter one) largely took a theological form. This chapter's theological outline draws from Gillespie's[504] quite detailed examination of Christian theological debates, especially those in the transition between the Middle Ages and Modernity. He argues that modernity is rooted in disputes and answers to questions about the relationship of nature, God, man and reason to one another, especially as these questions were confronted in the debate between Scholasticism and Nominalism, the latter arising as a challenge to the former in the 14th Century. The Nominalist challenge to Scholasticism opened up a metaphysical abyss, a "crisis,"[505] that prompted a sustained questioning of the nature of God that, according to Gillespie, is the origin of Modernity.

Scholastics saw creation as a reflection of divine reason, in which particular, worldly things aspired toward reality – understood to be universal and divine. The logic of Nominalism was basically the opposite – that universals, such as the names of categories of things, were merely symbols that facilitated human understanding, but particular, worldly things were what really existed.[506] Given that the world according to Scholasticism was a reflection of God, Scholasticism's syllogistic logic implied that God could be understood through the deployment of human reason. I.e., humans could improve their understanding of God by studying the world he created.

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[504] Gillespie.
[505] Ibid. 15.
[506] Ibid. 14.

Nature, in this view, was an interlocutor between God and man, and man's interest in it was motivated by his desire to know God.

In contrast, Nominalism proposed that, although God created the world, his creation was not an instantiation of divine reason, as was the case for Scholasticism. Therefore, according to Nominalist logic, God could *not* be known through studying the world, but only through his chosen revelations (scripture). The Nominalist God was largely unknowable – he could not even be captured in words – and therefore frightening. In contrast to the neat and whole version of the world that Scholasticism provided, Nominalism created an aporia. Moreover, although Nominalism unsettled Scholasticism, it did not entirely replace it.[507] Instead, the legacies of both metaphysical propositions, as well as the tensions between them, remain. Nominalism reinterpreted man and God naturalistically, but did not do away with or resolve the relation between nature/man/God—which surfaced in examinations of the question of whether man transcends nature. As Gillespie argues, the metaphysical struggle between natural necessity and free will was inscribed in modernity through theorization of this trio; Descartes argued that humans are natural *and* divine (he emphasized their corporeality and incorporeality) - the tinge of divinity the source of human free will; for Hobbes, humans were solely natural beings - therefore operating out of necessity. This syncretic legacy is embedded in disputes with regard to scientific knowledge writ large, and climate change in particular.

[507] Ibid. 16.

Probably the most significant legacy of the Nominalist/Scholastic debate for modernism, Gillespie illustrates, is that the Nominalist ontology, (asserting the reality of particulars) largely won out as a foundation of the individualism that characterizes modern thought. Individualism was not, however, entirely novel. Nominalist individualism resembles the philosophy of atoms that Lucretius explained in his meditation on nature in ancient Greece (probably during the 50s B.C.). More precisely, the Nominalist proposition that particular things constitute reality is quite similar to Lucretius' proposition that small units of matter –atoms— underlie reality.[508]

Indeed, Greenblatt proposes that the seeds of modernity were planted in Lucretius' poem, and that had no manuscript of it survived long enough to be rediscovered in the early fifteenth century (as was practically the case for the remainder of the works by Lucretius and his intellectual kin), the "modern" epoch would have been different.[509] Greenblatt's account itself emphasizes contingency, a concept that, especially in its competition with determinism, has roots in the tension between Scholasticism and Nominalism (as will be further illustrated below). Taken at face value, Gillespie's argument that the origins of modernity lie in a theological debate, and Greenblatt's argument that the origins of modernity lie in an ancient poem, seem to contradict one another. These propositions, however, have enough in common that they can be seen as complementary rather than competing assertions.

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[508] The individualist ontology of atoms is evident even when we think of molecules, which we think of as made up of atoms; we tend not to think of atoms as incomplete molecules, or entities awaiting the opportunity to form a molecular union.
[509] Greenblatt.

Ancient atomism and Nominalist individualism share more than the obvious parallels of particularism and individualism.

Much like the unknowable Nominalist God inspires fear, Lucretius' meditation on nature is, in essence, a contemplation of the fear of death. Though both of these philosophical traditions are substantially motivated by the fear of death, and share a particularistic ontology, they draw diverging conclusions about how to confront this fear. With Nominalism, fear of God (the creator of the particularistic universe) is intimately connected with the fear of death, which can accordingly only be palliated by the hope of salvation for individual souls in the afterlife. For Lucretius, "only the atoms are immortal."[510] Lucretius' theory, devoid of the purposeful guidance or meaning God provided, is part and parcel with his reasoning that the fear of death should be abandoned. Instead, because we are merely temporary atomic associations that will eventually reconfigure, he argues that life should be lived as an appreciation of beauty and pleasure. In either case, the meaning to be found in the universe is attributed to the significance of particulars.

For the purpose of this dissertation, the most significant difference between Nominalism and Atomism is that the former posited God as prime-mover, whereas the latter posited that atoms moved without the guidance of a deity, of their own accord. The differences between atomism and nominalism indicate that individualistic ontology does not give as clear an answer to questions of agency as the seemingly straight-forward formulation (i.e. "individuals" have agency) leads us to believe at

[510] Ibid. preface. (unpaginated ebook).

first glance. As Gillespie notes, "Lucretius used the term *voluntas* to name the innate power that each atom had to move itself apart from all other motions and collisions," but also used the same term to describe human motion.[511] Given that human beings are composed of atoms, we necessarily confront a contradiction in Lucretius' atomism and one that haunts naturalist science as well; the notions of causality and agency that are understood to apply in one sphere (nature/man/God) are called into question by the existence of another sphere. That is, if atoms have *voluntas*, humans are composed of atoms, and humans have *voluntas*, would not the *voluntas* of humans and atoms come into conflict with one another? Is the human subservient to the *voluntas* of the atom (or, to reference a more contemporary parallel, is human behavior overdetermined by genes?), or do humans have free will (e.g. consider the placebo effect), and if so, would this not call into question the agency of the atom? The relationship of these deeper ontological tensions to formulations of agency and causality, in the course of quests for scientific understanding, are illustrated in the next section.

Be Cause

The primacy of death and the notion of randomness as the (non)driver of change (reminiscent of Nominalism and Atomism) are at work in renowned evolutionary scientist[512] and author Stephen Jay Gould's treatise on "the nature of

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[511] Gillespie. 141,
[512] Gould's expertise covered many fields, including biology, geology and paleontology.

history," [513] in which he argues that history is utterly contingent.[514] That is, if one "rewound the tape," things would develop quite differently, leading to an entirely different result at the same point in time the second time round: "Perhaps the Grim Reaper of anatomical designs is only Lady Luck in disguise."[515] Gould takes the fossils from the Burgess Shale as his case (or, more specifically, he studies the studies of these fossils in the larger context of the evolution of knowledge about how life evolved) to argue that the principle of contingency is broadly applicable to the nature of history writ large. Gould argues that the ability of life forms to not die (i.e. to survive in order to reproduce) is the mechanism that determines the shape of future life forms, and the sources of death are largely random, likening survival to a lottery.[516]

For Gould, The Burgess illustrates (in a nominalist mode) that there is no telos at work in the evolution of life. More specifically, he emphasizes that there was a more wide-ranging array of anatomical features among fewer species during the period of the Burgess, yet many of those were evolutionary dead ends that have no descendants today; most of those species were going nowhere and their existence foreshadowed nothing about the future. Instead, history has turned out "endless

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[513] Stephen Jay Gould, *Wonderful Life : The Burgess Shale and the Nature of History* (New York: W.W. Norton, 1989).
[514] This is, similarly, a guiding assumption of certain academic traditions in Political Science, such as "Historical Institutionalism." (See Paul Pierson and Theda Skocpol, "Historical Institutionalism in Contemporary Political Science," *Political science: The state of the discipline* 3 (2002).) These "contingent" schools are juxtaposed with more "deterministic" traditions, such as "rational choice theory" (discussed below).
[515] Gould. 48.
[516] Ibid. 47.

variants upon a few surviving models" and "many more species based upon many fewer anatomical plans."[517]

Yet, one of the scientists who studied the Burgess (and to whom Gould gives much credit),[518] Stephen Conway Morris, takes this same phenomenon as evidence of "convergence."[519] That is, Morris theorizes that certain characteristics will inevitably evolve. For Morris there is some larger force that pulls life forms towards certain "functional solutions" – a logic that parallels the Scholastic ontology in which particular things are imperfect examples of universal principles that they strive to emulate. For Gould, however, the real determinants of history are the particular life forms themselves, which are subject to the whims of chance - in effect pulled nowhere by nothing. I.e., the particular things are what are "real," as in nominalism. The discrepancy between Gould and Morris is not only reminiscent of the quarrel between Nominalism and Scholasticism, but also similarly unresolvable. For Morris, evolution is somewhat predictable; for Gould, evolution is profoundly unpredictable. This is a reiteration of an ontological debate that cannot be resolved without knowledge of the unknowable. Echoes of this debate are heard in conflicts over whether or not climate change is predictable (as will be illustrated later in this chapter).

Gould published an entire series of essays whose "stock-in-trade" is formed by "the conversion of detail to wide message, through links of tangential

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[517] Ibid. 47.
[518] Ibid. There are more than two-dozen entries for Conway Morris in the index.
[519] "Debate over Evolution: Destiny or Happenstance?," in *To the Best of our Knowledge* (Public Radio International, 2011).

connection."[520] In one of those essays, he recounts opposing interpretations of the evolution of ichthyosaurs, an ancient and extinct group of reptiles with a fishlike appearance (e.g. fins in all the right places for proficient swimming).[521] Ichthyosaur fossils are a textbook case of convergence, and arguments with regard to the meaning and significance of this can be divided into two camps: the determinist and the contingent. The determinist side emphasizes the end, i.e. that these reptiles were able to "arrive" (though, it should be noted, they went extinct before the dinosaurs) at a quite fish-like form. The contingent side emphasizes, instead, the limitations that the reptilian ancestry placed upon Ichthyosaurs. As Gould put it:

> History is irrevocable. Once you adopt the ordinary body plan of a reptile, hundreds of options are forever closed, and future possibilities must unfold within the limits of inherited designs. Adaptive latitude is impressive, and natural selection (metaphorically speaking) is nothing if not ingenious. A terrestrial reptile may return to the sea and converge upon fishes in all important aspects of external form. But the similarity can only be, quite literally, skin deep and truly superficial. The convergence must be built with reptilian parts, and this historical signature of an evolutionary past cannot be erased.[522]

To put Gould's point more succinctly, Ichthyosaur ancestors were reptiles; therefore, Ichthyosaurs would remain reptiles, and never become fish.

Gould and other proponents of contingency emphasize that the past matters, and it constrains the possibilities for the future. The other side, however, does not contend that reptiles will become fish. They argue that certain arrangements of fins

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[520] Stephen Jay Gould, *Eight Little Piggies: Reflections in Natural History* (WW Norton & Company, 1994). 81.

[521] For a much more detailed and lengthy explanation of Ichthyosaurs, the fossil evidence, and its interpretation, see Ibid. "Bent Out of Shape," 79-94.

[522] Gould. *Eight Little Piggies.* 92.

will likely evolve in some species living in aquatic environments, given enough time and some basic morphological materials. In a similar vein, Morris (the advocate of convergence, mentioned above) argues not that "humans" were inevitable, but that (not necessarily human) *intelligence*, as an adaptation to complex environments, would inevitably arise in some form or another, given enough time. That is, believers in deterministic convergence argue that particular organisms embody varieties of abstracted, idealized forms.

The interpretation of Ichthyosaur fossils in the first published references, in 1708, adds an additional variety of a nominalist challenge to a scholastic interpretation. In the first references, not only were Ichthyosaur remains identified as fish (not reptiles that resemble fish), but figures of them were presented "to maintain that fossils are true remains of creatures that once lived, and not some manifestation of a plastic force inherent in rocks and ordained to establish global order by eliciting parallel forms in the organic and inorganic realms."[523]

An additional example of the nominalist/scholastic tension playing out through contingent/deterministic interpretations of evolution is the grounds on which Richard Owen, "England's greatest comparative anatomist"[524] and contemporary of Charles Darwin (who needs no introduction), disputed Darwin's characterization of evolution as following from natural selection. Owen rejected natural selection (not evolution) "as an excessively materialistic theory depending too much on external

[523] Ibid. 83.
[524] Ibid. 80.

environments and too little on laws of organic structure."[525] Darwin famously argued that the evolution of species results from the greater propensity for reproductive success of individuals with characteristics that are advantageous under their respective environmental conditions, which has been taken as the basis for the position that the nature of history is contingent. This formulation of contingency depends on a parallel framing of "the environment" as haphazard and unpredictable. If "the environment" in which an organism fails or succeeds at reproduction is predictable, then it would be easier to make the argument that natural selection supports a deterministic view of the world. Owen took issue with the theory of natural selection, arguing instead that it is the *form* (e.g. a certain arrangement of fins and flippers that is optimal for swimming) that takes precedence, and that different species, faced with similar circumstances (i.e. environments), will "converge" on similar structures, despite having different material to work with. Both arguments are, in effect, agreeing that evolution occurs through the interaction of the morphological traits of individuals with their environments. Where they differ is, to some degree, a matter of emphasis. In Owen's characterization, the ideal form pulls evolution toward it: the form determines the particular change. In Darwin's characterization, there is no ideal form, but rather a degree of happenstance in which the result is not determined.[526]

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[525] Ibid. 80.
[526] Curiously, in both cases, "the environment" is not regarded agentially, but rendered into context, i.e. background for action, and in that respect the environment itself is decontextualized.

The word evolution often serves as a synonym for progress, and like ‘modern,’ the moniker of ‘progress’ connotes not only that an entity comes more recently in time but that it is superior to its antecedents: inevitability and superiority here go hand-in-hand (i.e. a teleological, scholastic and deterministic interpretation). “The canonical representation of evolution,” the iconography of the “march of progress,” (i.e. any variety on the theme, moving from left to right, of a crouched-over ape like creature, progressing toward the right-most image of an upright man) conveys the message that humans are the pinnacle of evolution.[527] In other words, the popular cultural interpretation of evolution is deterministic and scholastic, with a modern conception of time as progress, and assumes that humans’ present form was both inevitable and superior to its evolutionary precursors.

The vision of human evolution as a product of nature, however, also invokes a distinction between man and nature. The “march of progress” presents modern man as the end of evolution (*into* man), not merely *from* one ancestor to the next. The relationship of man and nature that modernity outlines has it that not only does man (as all theologians were apt to call “him” until fairly recently) study nature, but a primary aim of his study of nature is to bring it under his control (e.g. in the form of technological “mastery” and property). Yet, the modernist conceit of human mastery over nature, through knowledge, is somewhat at odds with the question of how humans, as material entities themselves, came to be. This points, again to a metaphysical question of delineating between nature/man/God.

[527] Gould. *Wonderful Life.* 31.

Gould argues that the fossil evidence had been apt to be wrongly interpreted (in keeping with his criticism of the teleological paradigm evoked by iconographies of progress) as demonstrating that humans are the crowning achievement of evolution and a long time in the making, and bluntly states that these interpretations "are [wrongly] adopted because they nurture our hopes for a universe of intrinsic meaning defined in our own terms."[528] That may well be the case, but the basis of Gould's argument that the evolution of life was utterly contingent relies on certain metaphysical propositions as well. Gould's assertion that evolution was entirely random and that humans are an insignificant accident of evolution assumes that the motion of matter is *the* basis of reality and causality. Gould's is a *thought* experiment that does not answer whether the dice could have been rolled differently. 'A roll of the dice' can be as much a metaphor for God as it is for randomness – dice do not tend to roll themselves. Unsurprisingly, the deterministic explanation of evolution that Gould opposes contains a decidedly Scholastic telos, whereas the case Gould makes for contingency is radically Nominalist.

In Gould's characterization of evolutionary causality, change is owed to environmental catastrophes – events that amount to a "sudden and unpredictable change in the rules."[529] Quite important among these catastrophes are events that are caused by extraterrestrial bodies – i.e., external forces acting upon the environment and thus changing the environment in which natural selection takes place. The source of change is then, arguably, not so much the environment as the heavens. The ontic

[528] Ibid. 43.
[529] Ibid. 48.

supremacy of nature is maintained in this scenario, as mechanical motion is how the change occurs. Gould's notion of causality, however, emphasizes not mechanical motion writ large, but the action of *extraterrestrial* mechanical motion upon the environment. Gould is distinguishing between different realms of mechanical motion in order to make a more general causal claim, but where he makes the cut – extraterrestrial matter and motion—echoes the ontic category of God while maintaining the ontic primacy of nature that is so important to modernity. In providing a narrative of how humans happened to come along, but needn't have, Gould's causal explanation avoids questions about the relationship of God/nature/man only superficially. Mechanical motion itself only explains the movement from one domino to the next, not what caused the first domino to topple. Gould is distinguishing between different realms of mechanical motion in order to make a more general causal claim, and where he makes the cut echoes the ontic division between God and nature – alluding not to God but asteroids (matter in motion).

A similar mode of analysis is useful for understanding how we comprehend climate change. The parallels between the havoc that we understand both "carbon" and asteroids to be capable of wreaking are not subtle:

> *At the Springfield Science Fair*
>
> Principal Skinner: Now in second place, Lisa Simpson's grim description of our short-sighted dependence on fossil fuels.

> Lisa: (aggravated) It's about an asteroid! [which she predicts will crash into planet Earth]
>
> Superintendent Chalmers: (pinning the ribbon on Lisa) They're all the same Gloom-Hilda[530]

The asteroid of climate change is "carbon." Much like the asteroid draws a line between different realms of the functioning of nature that is reminiscent of a proposition explaining the relationship of God, nature, and man, "carbon" is an explanation of climate change that describes its cause naturalistically, while also suggesting a larger cause that invokes nature/man/God. That is, $C_{anthropos}$ is responsible for the *anthropogenic* climate change that is reason for concern. "Carbon" illuminates a conflict between man and nature (or perhaps, the difficulty of clearly distinguishing the purviews of each) as the grander and more consequential cause than the mere mechanical motion of atoms in space. In this depiction, "carbon" transcends mere mechanical causality while ostensibly adhering to it.[531]

Universal Atoms

Atoms, on the one hand, obviously evoke the particular (a la Nominalism), but on the other, they fall back to a more universal ontology (a la Scholasticism). That is, individual atoms are not entirely individual in the sense that they are of a type, and must follow the rules of that type. Lucretius had a typology of these types, and the

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[530] The Simpsons, *Replaceable You* ((Season 23, Episode 4)2011), Television Show.
[531] The frame of the "Anthropocene," examined in the concluding chapter, works somewhat in the reverse, as a blunt discourse that chastises humans for transgressing nature. It, like CARBON, has the effect of burying the metaphysical baggage that plagues climate politics.

periodic table is another categorization of types of atoms, e.g. that they have a weight of X and bond with Y under certain circumstances. Atoms are a syncretic blend of these universal qualities, reminiscent of Scholasticism, and the individualism and lack of direction characteristic of particulars that is owed to both Nominalism and Lucretius' Atomism. Atoms are therefore not radically particularistic, but belong to categories that science tells us hold universally, much like the universal categories that are reality under a Scholastic God. In this sense, atoms, the building blocks of matter and reality according to modern science, can be considered both ontologically Nominalist (i.e. particular, individual and undirected entities making up the world) but not entirely counter to Scholasticism, as they are also the bulwarks of universal categories. In other words, the universal properties of atoms, not merely their individuality as such, invigorates an individual atom's agency.

One illustration of this proposition - that particular atoms are powerful by virtue of their universal qualities – is to be found in this scientific account of how life on earth began. As told by science reporter Robert Krulwich, after gravity took hold of the Big Bang's "burst of energy," stars were created.

> Eventually a few of those stars blow up [… and] we get the first 12 or so minerals: atoms forged by starbursts. Carbon, nitrogen, silicon, iron… [and one of the original (and carbonic) minerals includes diamonds] teeny bits of diamond dust floating in deep space… Then gravity keeps on pulling dust together, forming asteroids [which beget planets, and on our planet, volcanoes and] plate tectonics that pull rocks on the surface down under, melting them, freezing them. Then water appears. [At this point, the number of minerals] has grown from the original 12 to about 1,500… [Then] life began… One very early form of pond scum figured out how to exhale oxygen into the air, and soon… our atmosphere had enough oxygen to create rust, to combine

> with organic chemicals to make creatures with shells and bones and those creatures died and became rocks… After life, the number [of minerals] jumps to 4,500.[532]

"Carbon's" identity as an atom (and the agency that implies) here is elevated to a position of further agential superiority relative to other atoms—a prime mover of movers. Krulwich's description has the "elements" of a creation story – rather than the beginning of life being purposefully initiated by God, it is the consequence of the unguided action of unconscious atoms (of these, $C_{element}$ steals the show), bonding together to form minerals. Yet, it is not simply the proliferation of individual $C_{element}$ atoms that matters, but $C_{element}$'s "universal" properties – e.g. its foundational role at the beginning of the universe. As will be demonstrated in the later section of this chapter, this is, uncoincidentally, one of many instances in which "carbon" is central to narratives regarding the fate of the world.

Ideas of Agency

Another variety on the theme of contingency/determinism is the issue of whether the obstacles to solving the climate problem are primarily ideational or material. Statements asserting that the scientific or technical knowledge to fix climate change exists, but the political wherewithal is lacking, exemplify this line of thought. For example, at a science communication workshop I attended, the policy director of an organization dedicated to teaching scientists how to effectively communicate

[532] Robert Krulwich, "My Grandson the Rock," NPR Science Blog, http://www.npr.org/blogs/krulwich/2010/09/14/129858314/my-grandson-the-rock.

environmental science said, “what we need in order to solve climate change is not more science—science has very little to add to the discussion—what we need is a culture change.” In these types of depictions of a contest between ideological and material explanations, ideas connote intentional agency as a driver of history, and material explanations are associated with a deterministic portrayal in which structure,[533] or “material agency,” “denies” (conscious) agency.[534] A flat ontology in which every “thing” has agency[535] provides a nice middle ground for methodological purposes. It does not, however, resolve, confront or explain the metaphysical dynamics of the research topics it examines.

Although Gillespie charts in great detail the theological developments that form modernity, it is worth noting that he includes both ideological and material forces in his explanation of the development of modernity. Gillespie proposes that Nominalism arose when it did because the fear-inspiring Nominalist God “only made sense” because of large changes that led to insecurity in Medieval Europe, e.g. The Hundred Years War, The Black Death and “dire economic circumstances” that were

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[533] For an overview of the ambiguities that arise with reference to agency and structure, particularly in relation to culture, see: Sharon Hays, "Structure and Agency and the Sticky Problem of Culture," *Sociological theory* (1994). For a discussion of ongoing debates regarding agency and structure in International Relations, see: Andreas Bieler and Adam David Morton, "The Gordian Knot of Agency—Structure in International Relations: A Neo-Gramscian Perspective," *European Journal of International Relations* 7, no. 1 (2001).
[534] This is context dependent and from other perspectives a bit strange. For example, Gould finds contingency entirely in a material realm in which ideas are not a candidate for consideration as causal factors—unless, of course, we categorize the functional forms of evolutionary “convergence” as ideas. In that case, ironically, these evolutionary idea(l)s are in line with a deterministic understanding of the world, not a contingent one.
[535] Bennett.

prompted by the climatic changes of The Little Ice Age.[536] In this example, we see Gillespie grappling with the same problems of causality that are posed by the question of nature/man/God that he has so meticulously studied. It is likely impossible to definitively determine whether it is "material" or "ideological" forces that have the greater influence on the other.[537] A tautological reading of this relationship is rather apropos, given their evidently circular dynamic. Not everything is knowable to people living at a given moment, death being a prime example. It is not possible to look back far enough to definitively attribute agency and causality, as all paths seem to lead to the question of the relationship between God/man/nature. This is just as it is not possible to discern the origins of this perplexing trifecta itself: the problem of data scarcity tends to intensify as we look back in time.

Metaphysical Conclusions

This tension between nominalist and scholastic ontologies points to a connection between ontological political conflict that can help contextualize other debates as well (e.g. the disagreement over whether intelligent design and/or evolution should be taught in schools), though it is not possible to explore each of these in the limited space of this project. The example of "rational choice" within political science is worth mentioning. This methodological approach to the study of

[536] Gillespie. 15.
[537] Where to draw a line between the two is not necessarily straight-forward, e.g. the line may depend on what timescale the changes are viewed from.

politics has become the subject of intense divisions within the discipline.[538] Rational choice theorists "seek to identify universal explanations for political behavior… by treating it the way physicists treat atoms and subatomic particles."[539] In order to explain trends in the aggregate, rational choice theory relies on an assumption that individuals are "rational." By "rational," what is meant is that individuals' actions will be motivated by the pursuit of their own "self-interest." Rational choice theory merges the search for universal truths and reverence for mathematical logic of Scholasticism, with the individualistic ontology of Nominalism. The theory proposes not only that politics has universal laws, but that individuals are subject to these universals (i.e. rationality), even through the exercise of their radical individuality. In effect, the methodology would therefore seem to foreclose investigation of – and perhaps even belief in – idiosyncratic political developments. In response, critics of rational choice argue that the theory has sacrificed the ability of political science to explain important, surprising political changes, for the sake of clear and elegant, yet politically inconsequential, investigations.[540] The critics' response is reminiscent of the Nominalist reaction to Scholasticism – the different camps disagree as to whether the world they study is fundamentally dis/orderly and un/predictable.

The assumption that agency lies with particulars is useful when making causal attributions, but its limitations that become apparent when individual agencies compete: e.g. atom v. human, individual human v. collective humanity, climate v.

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[538] J. Cohn, "When Did Political Science Forget About Politics?: Irrational Exuberance," *The New Republic*, October 25 1999.
[539] Ibid.
[540] Ibid.

human. This competition calls into question whether or to what extent the agents have the agency that is assumed (individualist and particular ontologies can only go so far in causal accounts). This difficulty has more commonly been understood through the frame of "the science wars," between social constructivists like Latour and Kuhn, and deterministic scientists. The former present a contingent view of science: "science might have done as good a job if it had never come up with either quarks or genes," while the latter assert "the inevitability of quarks," i.e. that science accurately represents the structure of reality.[541] A middle ground acknowledges this "genuine intellectual problem" as one without a definitive answer.[542] While there is, as Rorty argues, "no urgent need to put this perpetual seesaw to rest,"[543] Rorty is too quick to dismiss these as "philosophical differences [that] just do not matter that much." As the next section shows, the syncretic history of nominalism/scholasticism (contingency/determinism, etc.) is not only evident in the dominant discourse of CARBON, but explains how this discourse manages to foster conflict. At the limits of causal explanations and agential attributions lies the potential for metaphysically rooted conflict that is more than philosophical.

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[541] Richard Rorty, "Phony Science Wars " *The Atlantic Monthly*, November 1999. 120-122.
[542] Ian Hacking, quoted in Rorty.
[543] Rorty.

Data, Models, Carbon, Climate

The tensions described above (contingency/determinism, nominalism/scholasticism, particularism/universalism, etc.) are embedded within climate politics. Reading climate politics together with this metaphysical outline provides a novel explanation of the contentiousness of climate politics (see chapter three for an overview of more conventional explanations). This section will draw attention to how these tensions find expression in climate discourse through the frame of data/models. This section references different types of models and modelers that are engaged with climate science/politics, going beyond climate models *per se*; for example, economic models that are the foundation of allocating carbon permits or that are the basis for proposals to institute carbon taxes. The statements of climate modelers are central, but other instances of climate discourse are also included, demonstrating how the data/models tension applies more generally as well.

Much of the evidence drawn upon to make this argument comes in the form of ethnographic description from doing participatory observation in a regional climate-modeling lab. Regional modelers focus on understanding the climate patterns of "small" areas, e.g. Australia (as opposed to *global* climate). Their research draws from global climate models in order to work on their regional specializations (the relationship between global and regional models does not, generally, work in the other direction). In order to maintain the anonymity of my informants, identifying information is anonymized and information about the particular regions they study has been obscured (e.g. "land x" instead of the name of a particular landmass). To the modelers, the relationship between models and data was not straightforward or pre-ordained; rather, many varieties, combinations and incarnations of models and data were brought together by modelers in an ongoing process of negotiation: the finding of a successful negotiation was something "real."

It should be noted that the following exploration of data/models is not a repetition of the more simplistic "data versus models" debates between skeptics and believers. If anything, this analysis should shed light on why climate politics so often is comported through the language of data versus models. Paul Edwards begins his history of the development of climate knowledge[544] by confronting how deniers have used the models v. data frame to suggest that the theory of climate change is a *mere* theory, detached from reality. Edwards argues that the denialists are wrong because the climate cannot be known without models, and today climate data come to exist through models, not independently of or prior to them. In other words, Edwards is confronting denialists on epistemological grounds. He is illustrating how knowledge of the climate is made through a sophisticated and iterative process between "data" (which come from and re-form) "models." Deniers' invocation of data/models, however, is summoning the tensions embedded in the history of modernity to challenge climate activism on ontological grounds. This is a contest that is made possible through the conflicting conceptions with which moderns regard reality. The climate epistemology that Edwards details is a particular resolution of this tension,

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[544] Paul Edwards, *A Vast Machine: Computer Models, Climate Data, and the Politics of Global Warming* (MIT Press, 2010). (xviii).

but not an erasure of it. While climate "believers" point to knowledge that results from this epistemology as "real," deniers can use data/models to highlight the ontological instability out of which the believers' epistemology grows.

Many of the political challenges of climate activism, as in the case of the scientific interpretations described in the prior section, are a rendition of the metaphysical tension between nominalism/scholasticism (etc.). In the case of climate, this tension emerges through interpretations of the meaning of data and models, both in an abstract sense (e.g. dis/belief in the validity of modeling as a scientific method), and in their application (e.g. evaluating whether or how well a certain model fits particular data). The data/models dynamic frames climate politics at many levels, including governance; the assumption that models of the world can be used to change the world is a powerful influence on climate politics that goes beyond the boundaries of climate science. The interactions between the messy, un-model world, and models in and of the world, however, do not necessarily bring about results in accord with the aspirations conveyed through models. In other words, the political project of climate activism puts too much faith in the political utility of models themselves.

The Science of Modeling

As Edwards illustrates, there is not a clear line between models and data in climatology: "no collection of signals or observations… becomes global in time and space without first passing through a series of data models," and "[models] are filled with data—data that bind the models to measurable reality."[545] In other words, there is a great deal of modeling needed to create, evaluate or interpret data, as well as to merge data sets and make them compatible with one another. Nonetheless, within a given context, what are data and what is a model is fairly clear. Edwards himself repeatedly refers to data and models as separate entities with a particular relation to one another when describing more bounded circumstances.

Enormous accumulations of both data (e.g. surface temperature readings and values of CO_2 concentrations in ice core samples) and knowledge (e.g. that the ocean is a "carbon sink") contribute to the production of climate models (as do other models, as noted above)—no one senses the climate as a whole. In order to represent the global climate it is necessary not only to have an immense network of data collection devices and a social network with the capacity to distribute this information,[546] but data describing the climate in the past (years, decades, millennia…) must be included as well. The enormity of this task is compounded by "the tremendous unevenness of observations in space and time."[547] For example, much more data has been gathered, especially going further back in time, from the Northern Hemisphere than the Southern, and data gathered directly from the African continent is scarce as well, in relative terms. This overwhelming data project is in effect managed by the assumption that there is underlying order to be found. For example, with "reanalysis," the results of weather simulations are constrained with

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[545] Ibid. xiii.
[546] Edwards describes the "weather information infrastructure" and its development in chapters 9-10.
[547] Edwards. xv.

actual observations from instruments in order to produce “fully global, uniform data”[548] for climate models. Although many raw data are incommensurate or inaccurate,[549] they are combined into single data sets by using models to correct for the effects of their incongruous manners of collection.[550] The convergence of “global data images,” themselves produced by this process of synthesizing data and modeling, is taken as an indication that knowledge about the climate is getting better.[551]

The tension between models and data surfaces repeatedly in evaluations of the scientific merit of the theory of anthropogenic climate change, especially among atmospheric scientists. The frequently noted consensus of climate scientists could be more accurately described as an overwhelming consensus amongst numerical climate modelers, while the skepticism of some mainstream scientists (not including a vocal group of “contrarian” scientists outside the mainstream) “tends to be overlooked in the current popular and sociological literature on climate science politics.”[552] As Mayana Lahsen has documented through interviews with scientists and her analysis of related media coverage, the conclusions drawn from General Circulation Models (GCMs) (the fundamental tool for producing knowledge of anthropogenic climate change) are met with more doubt amongst the wider population of atmospheric

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548 Ibid. xv.
549 E.g., they may be taken using differently gauged thermometers, at weather stations whose name stayed the same but actual location shifted somewhat, recorded by an attendant with a tendency to drink on the job, the location may have stayed the same but the surroundings went from rural to urban, etc.
550 Edwards. Chapters 11-12.
551 Edwards. iii.
552 Myanna Lahsen, "Anatomy of Dissent: A Cultural Analysis of Climate Skepticism," *American Behavioral Scientist* 57, no. 6 (2013). 733.

scientists.[553] For example, "research meteorologists" who have trained in "synoptic methods" and "dynamicists," whose knowledge is more "theoretical" with a stronger focus on physics, tended to be more skeptical of GCM output.[554] One meteorologist described modelers as "so involved with running their models that they haven't put the time in thinking how the atmosphere works."[555] Modelers, of course, disagree.

Climate science, in keeping with its naturalist foundations, creates a representation of the world that has much less complexity and seemingly more coherence than the world it represents. That, after all, is the basic function of models. The line between "model" and "reality" is not clear-cut in the process of representing climate, however:

> modelers often gauge any given model's accuracy by comparing it with other models. However, the different models are generally based on the same equations and assumptions, so that agreement among them may indicate very little about their realism…. GCMs [Global Climate Models] are used in order to 'massage' the very data sets fed into the GCMs in the first place to render them consistent and broadly applicable.[556]

Put more bluntly, Lahsen is describing the relationship between climate data and climate models in the development of GCMs as tautological. Her conceptualization of "realism" assumes that climate models are rather straight-forward representations of the climate, and that a fidelity to realism requires a clearer line between that which is represented—the climate (data)—and representations of the climate (models). The ontology of this assumption is nominalist; the "real" world is one of particular data,

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[553] Ibid.
[554] Ibid. 733.
[555] Ibid. 743.
[556] Myanna Lahsen, "Seductive Simulations? Uncertainty Distribution around Climate Models," *Social Studies of Science* 35, no. 6 (2005). 899.

and for models to pass the test of "realism" they should follow from these particulars rather directly, rather than from other models (which are implicitly less real). This nominalist ontology is out of sync with the scholastic ontology that underpinned the process of regional climate modeling that I witnessed as a participant observer, described below.

In order to "believe" in anthropogenic climate change, i.e. to categorize *it* as "real," as it is frequently described in colloquial, political, discussion, it is necessary to accept the underlying assumption that the climate does work according to general principles. As Weber argued, the more general a phenomenon, the more possible it is to formulate a general law,[557] but the existence of general principles governing the climate must be assumed before the particular principles can be "discovered." This leaves the question of to what extent climate does work according to generalizable principles perpetually open in a metaphysical sense.

This metaphysical aporia helps to explain the ongoing proclamations by activists that "climate change is real." If the "reality" of climate change were not, on some level, being questioned, it would not be necessary to put so much persistent effort into merely asserting its existence: animal rescue organizations do not need to establish that cats and dogs exist. Just as models build not on data alone, but also upon other models, it is easier to speak with reference to the neater messages conveyed with models, than to the data—data do not speak for themselves.[558] The

[557] Moses and Knutson. 34.
[558] Latour and Woolgar, "Laboratory Life: The Construction of Scientific Facts." See also, Michel Callon, "Some Elements of a Sociology of Translation: Domestication of the Scallops

notion that the world or "reality" is "messy" comes from a similarly nominalist vein that implicitly assumes that particular things are what is real, and that "neat" representations of the "messy" world, such as models, are inherently imperfect, albeit at times appropriate or necessary attempts to describe and understand "reality." John Law implies that reality can be partitioned, roughly, into two categories: the parts that can be captured with some simplicity, and the more "ephemeral and elusive" messiness of the world, which is done an injustice through traditional, simplifying methods of social science research.[559] He opens his book by citing "global CO_2 emissions" as one of the "things in the world" that "can indeed be made clear and definite" and that social science can deal with "more or less effectively."[560] His primary concern, however, is with the "realities we are currently missing,"[561] because of their messiness. That he places CO_2 emissions on the more solid side of the dichotomy illustrates a key point herein: that "carbon" is an exemplary case of a politics that is rooted in "reality."

The tension between models and data shows up not only with regard to knowledge production about the climate, but also with regard to knowledge production about climate science skeptics: "Any given individual's behavior is overdetermined by a mix of idiosyncratic and shared (e.g., cultural) factors, and climate skepticism is similarly overdetermined."[562,563] There is a strong association

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and the Fishermen of St Brieuc Bay," *The Sociological Review* 32 (1984).
559 John Law, *After Method: Mess in Social Science Research* (Routledge, 2004).
560 Ibid. 2.
561 Ibid. 2.
562 Lahsen. *Anatomy of Dissent.* 736.

between these differences in epistemological orientation and the generation of the scientist. Skeptics are likely to be older, and to have received different training that did not privilege modeling, as is the case now. There is, however, a trend toward less skepticism that is fed, at the least, by the generational gap as the older generation retires or expires, and younger scientists are initiated in an environment that puts more training and emphasis on modeling.

The generational differences have been attributed to a shift in emphasis of funding criteria, particularly that of the federally administered National Science Foundation in the U.S., away from "basic" and "pure" scientific research, and toward "broader impacts." The "ideal" science of the former, e.g. theoretical physics, "searches for first principles and a unitary theory of the world,"[564] whereas the latter prioritizes concrete societal or practical applications. This shift can itself be put in the context of tension between determinism (as seen in the search for first principles and unitary theories) and contingency (as valuing "practical applications" implies a more contingent vision of a world in which humans use their knowledge of the world in order to shape it).

Many of these demographic and disciplinary trends, and the epistemological differences that accompany them, are illustrated by a strange episode in the summer

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[563] A similar dynamic can be noted with regard to non-scientists. For example, Whitmarsh finds that "Demographic factors, such as age, gender, income and education, were significant bivariate determinants of uncertainty and scepticism; but were found to be mediated by environmental and political values" in her survey of UK respondents: Lorraine Whitmarsh, "Scepticism and Uncertainty About Climate Change: Dimensions, Determinants and Change over Time," *Global Environmental Change* 21, no. 2 (2011).
[564] Lahsen. *Anatomy of Dissent.* 737.

of 2012, when the Berkeley Earth Surface Temperature lab, known by the humble acronym BEST, published a paper[565] arguing something that the climate modeling community had long-ago begun to regard as “fact”: that mean global temperatures were rising, and that the rise could be attributed to CO_2.[566] The lab is an independent non-profit, and therefore is not constrained by the NSF’s scrutiny with regard to “broader impacts” and “practical applications.” The founder of the lab, Richard Muller, a physicist (as were most of the scientists affiliated with the lab) who was born just prior to the baby boom, had been a vocal “climate skeptic,” (a factor that likely enticed the conservative Koch bothers to donate $150,000 to the lab when it was first established).[567]

BEST reached its conclusion through an extremely complex statistical method that reconstructed land surface temperatures going back in time, not through climate modeling. In an editorial in the New York Times,[568] Muller announced that he was a “converted” skeptic, and described BEST’s methodology as “completely automated and hands-off,” free from “human intervention and data adjustment,” and not

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[565] Robert Rohde et al., "A New Estimate of the Average Earth Surface Land Temperature Spanning 1753 to 2011," *Geoinformatics & Geostatistics: An Overview* 1, no. 1 (2013). Originally published at http://static.berkeleyearth.org/papers/Results-Paper-Berkeley-Earth.pdf.
[566] For a description of the project by the outspoken organizer of the lab, Richard Mueller, which includes a summation of their methodology and “his” idea of testing whether CO2 emissions fit the curve (giving no acknowledgment that climate modelers had worked from the premise that CO2 was the primary forcing of global warming for decades), see:"Richard Muller: I Was Wrong on Climate Change," https://www.youtube.com/watch?v=Sme8WQ4Wb5w.
[567] BEST (Berkeley Earth Surface Temperature lab), "Funders," http://berkeleyearth.org/funders/.
[568] Richard Muller, "The Conversion of a Climate-Change Skeptic," *The New York Times*, July 30 2012.http://www.nytimes.com/2012/07/30/opinion/the-conversion-of-a-climate-change-skeptic.html?_r=0

dependent on GCMs, "the huge computer programs that are notorious for their hidden assumptions and adjustable parameters." In keeping with the search for universals of "pure" physics, Muller touted that BEST's "result is based simply on the close agreement between the shape of the observed temperature rise and the known greenhouse gas increase." One modeler in the regional lab questioned BEST's "reconstruction" of climate data, noting BEST had high "confidence in their data going back, but I'm not sure why that is; the number of stations going back farther gets sparser and sparser, plus there are not a lot of people in the southern hemisphere. Central Asia, forget it. Europe and the U.S. have the most coverage." BEST's statistically derived reconstruction of the data after 1900 was, nonetheless, "so similar, like uncannily similar, to what has already been found." He impugned Muller for "making a lot of noise for data people have looked at before; he's just using a different methodology, but it's the same data." They were in stark dis/agreement.

Modelers found BEST's simultaneous and well publicized confirmation of the message they had been trying to get across to the public, and dismissal of the methods they had used to repeatedly reach and document that conclusion, galling. In the regional lab, one modeler's reaction to Muller's "throwing out global climate models" was to exasperatedly ask, "How does he think we know anything about the future? We're just going to extrapolate a linear trend or something? Linear trends aren't what the models show." He went on to say, "what I don't get is why he's so vociferous about it, super blowhard," and "he's treading very close to crazy territory." Although the climate modeling community and BEST now agreed that the earth had warmed significantly due to anthropogenic CO_2 emissions, their disagreement with regard to data and models only fanned the flames of climate politics. A public "battle" (as one of the regional modelers described it) between Michael Mann, a prominent global modeler, and Muller ensued, [569] and media coverage of the controversy surrounding BEST was wide spread, with Muller making the rounds on national media outlets.

The self-description of a PhD candidate in the regional lab I observed reflected the other side of the coin with regard to the generational changes within atmospheric science. She stated, "I can do programming, but I don't enjoy it." She explained she started doing modeling in her graduate program because she was interested in climate; therefore modeling was "necessary" for her to do. She went on to state that another modeler who formerly worked in their lab "can do code like nobody's business. I can't do that. I mean I can do science. I only do code to get to the science." This implies a dichotomy at work between science and code, even among modelers; i.e., modeling is not quite the same as science, rather it is a tool to arrive at a scientific conclusion.

The process of getting to "the science" is, however, more complex and iterative than this dichotomy portrays. Although I came to the regional modeling lab looking for "carbon," there was not much "carbon" to be found; there was, however, plenty of "reality." In the lab, the science/reality/truth is arrived at through a long negotiation between (most prominently, but not exclusively) code, data, models and

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[569] One of the modelers pointed me toward the following: Michael Mann, "Something Is Rotten at the New York Times," http://www.huffingtonpost.com/michael-e-mann/michael-mann-richard-muller_b_4313508.html.

knowledge, and mediated by human judgment. The following are excerpts from one conversation in which modeler two is assisting modeler one:

> Modeler one: Sorry, too much code…
> Modeler two: let's take a look at that; that might be interesting. Yeah, I wonder if we're just masking out the wrong way.
> Modeler one: [long pause] That looks weird. Cause latent heat should be on the land surface
> Modeler two: Yeah, that's really strange… There are some really goofy shapes in there. I don't know what to make of that. But maybe that's just a function of the cloudiness in this region.
> Modeler one: Is there a way you can plot or extract clouds?
> Modeler two: …it's incoherent. Yeah let me look at the t-test stuff again and nail it down
> Modeler one: Yeah, it's confusing. Is there a better test? The statistics seem strange.

In the course of the mediation process, glimmers of "reality" emerge. The conversation closes as such:

> Modeler two: it seemed to have the same population variances, which is probably true
> Modeler one: yeah, it's not like it's a different planet
> Modeler two: yeah, no reason to expect that there's a substantial difference

During the negotiating process, weirdness, strangeness, confusion, "incoherence," and "goofy shapes" emerge, but when different negotiators come into accord in some way, e.g. the same population variances, the modelers see glimpses of truth and reality.

The conversation above is a rather typical interaction between the modelers engaged in this mediation process. Many of the modelers' interactions follow this form, in which they work from a combination of their knowledge of climatic processes, their technical abilities (coding, etc.), and in collaboration with one another, in an ongoing and reiterative process of evaluating, refining and matching different combinations and variations of data and models (variables like clouds are removed, different statistical tests are tried, parameterizations are adjusted, etc.). One modeler in the regional lab explained that global models are "run really coarse," so "changes aren't visible at that [smaller, regional] resolution," meaning "the climate data is at a bigger scale than the land use data, which is at a finer scale, so it's hard to look at how land use affects climate." Her research examining the effect of land use on regional climate, therefore, involved many attempts to reconcile climate models/data with land use data so that the two could speak to each other.

In the course of bringing data and models into accord, modelers incorporate many accouterments, such as knowledge of a particular discipline or place, technical know-how, computer servers, and funding. The process works like a negotiation between various parts—code, modelers, models, computer servers, modelers' knowledge—with the modelers' judgment evaluating each iteration and responding by trying different adjustments. A modeler's choice of models is constrained by the capacity of their server, which is constrained by funding. Along the way the various negotiators are active in the process: computer servers are down, or difficult to reach, or working (for the time-being); other modelers go out of town and their knowledge of a particular aspect of the climate or a particular model is hard to reach for a time; after attempts to combine data sets though programming, GIS is tried (and it takes a week to secure a password to do the GIS). One modeler described the difficulty she was having at one moment, as "the data hasn't caught up to the code." Eventually, over a period of weeks or months (or even years), enough glimmers of reality emerge and combine to tell a "story" that is "coherent" (two terms that were often repeated), and can be written up in a paper and submitted for publication.

"Reality" emerges gradually as modelers, in their role as mediators, engage in a long process of negotiation between (more than) models and data. This process appears to be the norm. The following excerpt from a conference call over skype, during which one of the modelers from the regional lab reports out to a group of collaborators on a project-in-process, was given and received as business as usual:

> It looks really noisy, I think that's due to the chaotic nature of the activity, *it's hard to pin it down just yet…* that's *my initial suspicion*.
> [back and forth dialogue with another modeler on the call]
> *What's the real effect and what's the noisiness is a good question*. Again the patterns are concentrated in the southwestern part of [X]. Something interesting is popping up in [subset of X]. Too many instances in those areas where the differences can't really be calculated… So there is some sort of *effect that I think is probably real…*
> So I think the story *so far* is that these are *definitely real* and significant [in the warm season], but in the cold season it's harder to say…[emphasis added]

On a different occasion, while talking with another modeler in the lab, a senior researcher commented on his junior's work:

> Hmmm, that's cool. Look at [that - how the precipitation in the region changed dramatically-] it was during el nino, which is exactly what you'd expect… Yeah, I think you've really got a really *coherent story coming together…* in all these analyses it *takes awhile to feel* like you're getting to a point where *you're really getting it*. I always feel like that. [emphasis added]

In another instance, involving another conference call between half-a-dozen or so labs, one modeler in a distant lab remarked, in response to another distant modeler's presentation, "it just seems like you're at the point now where you can start to do some real comparisons; it's cool." To which the presenter replied, "it's a bit relieving to feel like there's something kinda real to work with."

In the above examples, reality comes into being not as dry, impersonal "fact." Rather, its emergence is accompanied by the genuine excitement of modelers: finding something real to work with is "relieving"; coming to the point of doing real comparisons is "cool"; the modeler *feels* like he's getting to a point where he's really getting it. These statements reflect the incremental character of the modeler's mediating role between models and data (and their accouterments), as well as the role of judgment, which is expressed not only as knowledge, but also intuition. The following exchange is taken from two other modelers on a Skype conference call:

> Modeler one: We see there's an OK correlation between the model values and the measurement values… This correlation I think is really quite good… I do still think that the inter-annual changes are quite well correlated between these two sites. There is a climate influence that's affecting both of these sites similarly, which I think is a good result…
> Modeler two: Pretty impressive when you think about it
> Modeler one: I agree that it's pretty good. The problem I was having before was [technical details…]. So I'm pretty pleased with how the model is performing.

In modeler two's repeated emphasis on correlation and description of the correlation as the "result," she is painting the model as a tool for finding patterns and trends, expressed in a correlation between data values under model conditions. The model is not a straight-forward representation of (nominalist) reality, but rather a tool to find the general rules of (scholastic) reality. The following exchange, later in the conference call, between other modelers (three and four) and one of the modelers above (one), similarly indicates the relationship between models and "reality" that modelers perceive:

> Modeler three: soil evaporation is, I guess, something we assume doesn't occur

> Modeler one: or it's something we don't account for
> Modeler four: super complicated… So you could see if you could isolate the condensation effects or something.
> Modeler one: what would be a good way to isolate where the moisture is coming from?
> [more exchanges of technical details]
> Modeler four: [in a] tagging experiment [you could] control for where the moisture is coming from using model data

Modeler one's clarification of modeler three's statement that says soil evaporation is "something we assume doesn't occur," is pointing out that modeler one's statement should not be taken too literally. In other words, soil evaporation is not included in the model, but its lack of inclusion does not mean that they do not think it is occurring. In other words, they interpret models from a more scholastic than nominalist standpoint with regard to "reality," and recognize that models have limits to how much they can convey.

In the context of the negotiation between data and models that modelers mediated, "reality" described general correlations, patterns and trends—echoing scholasticism and universalism. Later in the conference call mentioned above, modeler four remarked, "so we're trying to figure out the dominant physical processes that are creating this regression pattern… It's not entirely clear which is the dominant influence right now." In other words, the "dominant physical processes" are the reality she expects to find, and she has not yet been able to discern this reality from the particulars that form a regression pattern.

The language of "reality" did not, however, pair with discussion of climate scenarios and forecasts. Rather, predictions invoked contingency. Comparisons of a particular "point" (e.g. temperature and other climate data from a 10 square km area), under different experimental conditions (e.g. different land-use configurations) would be presented as a means of describing and testing those general rules; the point was not to create knowledge about the particular place. There was no indication that modelers believed these particular readings would actually emerge, even under the same conditions as the model scenario. Rather, the points were taken as illustrations of more general principles—e.g. that deforestation could change temperature and precipitation patterns within a region—and also illustrated, rather explicitly, that future climate was not determined, but could go in many directions.

A conversation I had with two modelers explicitly confirmed their understanding of "reality" in a much more scholastic rather than nominalist sense:

> Modeler 2: the point is the model output gives you one possible outcome, but because you know it's not perfectly representing reality, then you don't expect that to be exactly what happens.
> Me: because the model doesn't represent reality?
> Modeler 2: yeah exactly
> Modeler 1: yeah
> Modeler 2: so there's that. But there's another point with weather and climate, and this is something that's really important, which is that it's chaotic.
> Modeler 1: yeah
> Modeler 2: so any particular outcome is one possibility, so the way that you get around this in climate modeling is that you change the initial conditions a little bit and then you run a whole bunch, like an ensemble of runs, and then you average over that, and then you say the average of that ensemble is the most likely outcome…. Something that's robust across models, and across an ensemble, is usually something you can believe in.
> […]
> me: so would you say that what you learn from the models is a confirmation of more general principles of the climate?
> Modeler 1: yeah
> Modeler 2: um hm [in clear agreement]
> Me: then that's the reality or truth or real thing that you're finding in the model, as compared to the predictions or the particular thing…

Modeler 1: yeah, yeah
Me: in the predictions, it's not exactly what you mean by [interjection by modeler 2]
Modeler 2: it's not deterministic
Me: it's not deterministic?
Modeler 1: right

In short, with regard to climate models, the general is more "real" than the particular.

The sense in which "reality" is often used in more explicitly political discussions of anthropogenic climate change, however, differs from how "reality" emerges in the course of negotiating data/models. When Canadian Prime Minister Justin Trudeau announced a mandate that territories and provinces implement a carbon tax, he stated "there is no hiding from climate change" because "it is real and it is everywhere."[570] Statements such as this pervade political discussions of the climate problem. The declaration of climate change as "real" seems to invite challenges to its existence as a (singular yet broad) phenomenon. In those political discussions, global warming's "reality" tends to be questioned in a nominalist mode that is out of sync with the scholastic understanding of reality that emerges from climate models. Climate change as a phenomenon becomes known, epistemologically, through negotiating between data and models. This system melds two competing ontologies by making adjustments to its representations of nominalist reality, in the service of discovering scholastic reality. The gap between these ontologies, however, also creates an opening for contestation. In other words, the

[570] Christopher Gully, "Canadian Government Says It Will Implement a Nationwide Carbon Tax by 2018," *Los Angeles Times*, October 3 2016. http://www.latimes.com/world/mexico-americas/la-fg-canada-carbon-tax-20161003-snap-story.html

political arguments surrounding whether or not climate change is real are a reflection of the insecure foundation of "reality" itself.

Models and Contention

The epistemological differences among atmospheric scientists, described above, are expressed in large part outside of academic journal articles, and show up in "more political" places (as was the case in the BEST controversy described above).[571] For example, a representative of the Cato Institute (a neoliberal think-tank with "anti-climate" leanings) told Lahsen, "The computer models predict all kinds of horrors and costly environmental consequences. But there is no data! This is a computer model."[572] In one exchange in the regional modeling lab, I mention that I've been watching U.S. Senate hearings on climate change, and that, while experts testify, some senators remark that they have looked at the data themselves, and used it to draw their own conclusions. The response of one modeler: "I don't try to look at my own x-rays to try and figure out what's going on."

The tension between data and models often emerges in reference to the uncertainty of scientific knowledge—as the future is known only probabilistically, not with absolute certainty.[573] Take the finding of an article in *Nature Climate*

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[571] While the BEST paper was eventually published in an academic journal, Mueller publicized the findings before the peer review process was complete and posted the paper online prior to publication.
[572] Lahsen. *Anatomy of Dissent.* 733.
[573] In the program Boyle established (see discussion in chapter one), the legitimacy of experimentally produced knowledge was based in a probabilistic view of knowledge, wherein certainty was not total; the lack of absolute certainty of this knowledge was, for Hobbes,

Science, published during the meeting of the COP in Paris in 2015 (this co-incidence likely increased the amount of media attention the article received), that "[g]lobal emissions of carbon dioxide from burning fossil fuels and industry are on track to level off or perhaps even dip slightly this year."[574] The researchers attributed the potential decline to China's economic slowdown (and correspondingly lowered rate of coal consumption) and its growing renewable sector (which, incidentally, is attributed to China's efforts to ameliorate its massive air pollution problem[575]). A geologist, asked by *Nature* to comment on the study, answered, "the biggest uncertainty is the Chinese data." One of the study's co-authors noted her hope that the Paris talks would lead to "a more rigorous and verifiable way" of emissions tracking and reporting: "We have to rely on the countries to tell us what types of coal they use and how clean it is. If the reporting was systematic, it would be wonderful." While, in this case, uncertainty is seen to result from questions about the representativeness of the data being reported, from another angle, uncertainty about the significance of this study is linked to the strictures of the model. For instance, the article ends by noting that the report "does not fully reflect the carbon emissions associated with deforestation and other land-use changes." The implication is that the model does not incorporate all the C_{GHG} that matters.

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ground for why the experimental method could not be the basis for philosophy and could not produce truth: Shapin and Schaffer. 22-24.

[574] Kenneth R. Weiss, "Global Greenhouse-Gas Emissions Set to Fall in 2015: China's Reduced Appetite for Coal Drives a Surprising Departure from a Long-Term Trend," *Nature International Weekly Journal of Science* (2015). http://www.nature.com/news/global-greenhouse-gas-emissions-set-to-fall-in-2015-1.18965

[575] The above article (Ibid) makes this link, to which it should be added that China's ability to point to its growing renewable sector has the added side benefit of enabling allusions to the climate benefits of renewables.

In either case—doubt with regard to the validity of models versus data—agreement regarding the centrality of "carbon" coincides with disagreement about how to properly represent "carbon" data and interpolate its significance using models. A perfect answer, capable of reducing either objection to the point that it could no longer be quibbled with, would mean, in essence, that the model and data had achieved convergence not only with one another, but, presumably, with the world that was no longer represented by it, but, rather, replicated by it. Only in the event of this impossibility could knowledge of what is "real" be settled; i.e. there would be no gap between data and models. In other words, when climate activists keep the political argument centered on "reality" (which the "carbon" project is part and parcel of) they put themselves at a strategic disadvantage.

When "reality" is what is at issue, debate perpetuates; and reality is what is being debated in the arguments surrounding models/data and "carbon." Skeptics can point to imperfect matches between models and data to question the truth-value of conclusions drawn from models—an argument that proponents of models can turn on its head to justify the value of knowledge produced by models. Steven Schneider, the late, well-known global modeler and astute climate activist, put it this way:

> The other side says "[if you put] garbage in [to the model], garbage [comes] out; if you haven't got all the details, how can you couple everything together." And my answer is: [if you don't and instead wait until more precise data is available for input in the models] by the time you get that, we'll already know the answer because you just go outside and see what happened. And that is not ethical in my value system.[576]

[576] Lahsen. *Anatomy of Dissent.* 738.

Physicist and outspoken contrarian, the late Frederick Seitz, expressed a starkly different epistemological orientation with reference to models and data. Regarding models and modelers, in an interview with Lahsen, Seitz said,

> They call them experiments, but they are not tied necessarily to observations out there, in the real world […] But, I come out of the traditional attitude towards science that ultimately you have to use observations as your base […] then see where you come out. To date, there is no significant evidence that we're in impending danger.[577]

In other words, he does not accept that the projection of a model qualifies as "evidence." Model projections produce what could be described as "contingent data," i.e. data that depended upon a model in order to come into being.[578] Lahsen summarizes Seitz's conclusion as a rejection of "the epistemological status of GCM output as data."[579] The outputs of models, for modelers like Schneider, are data from which climate scenarios that reveal real climate trends can be made. Whether or not these contingent data are a valid basis for making claims about knowing the climate is what is at issue. Evaluations in that vein can be debated on philosophical or political grounds, but due to the unclear ontological status of contingent data, there is not an objective way to make that determination.

As alluded to above, beneath the "uncertainty" of climate models is the aporia between nominalist/contingent data and scholastic/deterministic trends. One way that

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[577] Ibid. 739.

[578] Edwards classifies GCMs as either simulation models, reanalysis models, or data models. The first simulates the climate with a focus on atmospheric physics, the second blends simulation with observation to produce global datasets, and the third is based on using sophisticated techniques to adjust the readings of instruments. "Contingent Data" encompasses the latter two.

[579] Lahsen. *Anatomy of Dissent.* 740.

climate science, particularly the IPCC, has approached this uncertainty/aporia—climate scenarios[580]—is, again, an ontological balancing act. On the one hand, the scenarios convey a determined vision of the future, in which "carbon" *will* warm the planet. On the other hand, the scenarios do so by presenting multiple futures: which future comes about is contingent on human actions with regard to "carbon." Relatedly, climate communicators[581] have framed uncertainty by describing climate scenarios as conservative. The conservativeness of climate science has its own political implication: the public statements of climate science often convey that the problem is probably going to be much worse than model forecasts – i.e., as more is learned, the estimated climate impacts are likely to become more dramatic. This 2010 description of a 1979 assessment is demonstrative:

> The available evidence suggested that ocean mixing [because heat tends to sink to the bottom of the ocean] was sufficient to delay the Earth's atmospheric warming for several decades. Greenhouse gases would start to alter the atmosphere immediately – they already had – but it would take decades before the effects would be pronounced enough for people to really see and feel. This had very serious consequences: it meant that you might not be able to prove that warming was under way, even though it really was, and by the time you could prove it, it would be too late to stop it.[582]

In other words, the uncertainty of the model meant that warming was destined, *perhaps*.

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[580] IPCC, "Climate Change 2014 (5th) Synthesis Report Summary for Policymakers." See especially pages 21-23.
[581] See discussion on pages 277-278.
[582] Oreskes and Conway. 173.

This paradox can also be attributed to the ontological indeterminacy[583] of climate change as an object of study. How we think about and debate what is likely - i.e. uncertain - to unfold in the future can change the state of affairs in the present, which in turn may influence what happens in the future, further complicating the range of considerations necessary for making projections about the future. In other words, some of the "uncertainty" surrounding climate change is a consequence of the known-to-be-unknown course of future events, especially those that are subject to human action. Indeed, influencing the course of human action in order to affect the form of future climate is, arguably, the basic mission of climate science; and regulating human interaction with "carbon" is its proposal for how society should be reordered.

A/political word

C_{word} conveyed two basic meanings in the regional lab. First, it communicated basic assumptions and principles of how the climate works, and it did so largely in the background. Second, it communicated a normative, political position that something should be done to change course. The political mission associated with "carbon" was, perhaps counter-intuitively, evident in the surprisingly rare instances in which C_{word} was mentioned in the regional modeling lab. Significantly, the modelers would mention C_{word} when they were informally engaging in conversation with me, and

583 Astrid Schraeder, "Responding to Pfiesteria Piscidia (the Fish Killer): Phantomatic Ontologies, Indeterminacy, and Responsibility in Toxic Microbiology," *Social Studies of Science* 40, no. 2 (2010).

rarely with one another. When they did mention it to one another, C_{word} seemed to be mentioned as a way to reference the political imperative of addressing environmental concerns (and perhaps for my benefit), rather than as part of their research program. One modeler, speaking to another, said:

> [A different research team working on this region] got 150 for sensible heat, [more mentions comparing numbers..] so mine's in the ballpark. There are still large areas of virgin forest that are disappearing as we speak. They're starting to convert ["natural" land feature] to [commercial agricultural product] plantations, which is really a bad bad thing for the carbon cycle. I'll look at the latent sensible heat and see what we can come up with.

At other times when C_{word} was mentioned, it was in the context of a researcher explaining basic climate science to me, at my request. One modeler explained:

> A forcing drives changes [explanation of earth's orbit as one forcing important to understanding interglacial theory…]. Earth's orbital parameters aren't really changing in the short time scale we're looking at now, and CO_2 is what has been changing, so it's the primary forcing.

When I asked the modelers how C_{word} came up in their own research, they explained that the main way they interacted with CO_2 was through IPCC scenarios. They work from the "different models of CO_2 that the IPCC lays out."

Most frequently, C_{word} came up in our discussions that focused explicitly on the politics of climate change. It is typical for climate modelers to have some familiarity with "climate communication." One modeler in the regional lab reported that in her graduate training "there's a lot of emphasis on how to talk to non-scientists. It's like we have to do PR because the media gets it wrong." The Union of Concerned Scientists is one of many organizations that offers formal trainings for climate scientists to learn to speak to the public. One modeler in the regional lab, who had taken one such training and received occasional email updates on the topic, said

> we frame the problem as too much CO_2 in the atmosphere, so then we could emphasize a solution, like let's go renewable… The message is there's too much CO_2 in the atmosphere and it's making the earth warmer. If you want to just get one message across, that's probably the message you want to get out there. Cause otherwise you start getting into more whacky things like changing our light bulbs. You can't just expect them to go start doing all those things like you'd expect or want them to.

The modelers were clearly frustrated at the lack of political progress on climate change. In the same conversation mentioned above, the modeler asked me whether I thought there needed to be "a new approach to the messaging" of climate activism, and stated "maybe scientists can't move the conversation anymore." When I asked his opinion of Bill McKibbon's 350.org (a prominent environmental initiative that pushes to bring the concentration of CO_2 in the atmosphere down to 350 parts per million), he shared his interpretation that "350 was the IPCC political decision," and not a scientifically determined number, as McKibben portrays.

Ironically, in more explicitly political venues, however, C_{word} connotes "science." As I was conducting research for this dissertation I attended an intensive science-policy communication workshop. In a conversation I had with the policy director of a science messaging organization at the workshop, he stated "if we're still talking about this [climate] in terms of carbon, we're talking in a scientific sense, and that's not going to help politically."

Despite the rarity of $C_{word's}$ mention in the lab, the CARBON discourse was at work. In the political discussion referenced above, the modeler stated he thought "it is going to come down to some president saying that we're going to convert half the country's power to renewable in X number of years, and that's that"—suggesting a reordering of energy flows but not of social organization. After making that statement, he went online and began looking up and sharing information with regard to CO_2 emissions: CO_2 emissions in the U.S. peaked in 73; U.S. is at 98 levels, despite growing; China's per capita rate is lower than the U.S., "but their trend is up, up, up. We're at 17 per person and China is at 5, so if everybody in China got to our level…"; The U.S. is at 25% of world's coal, China at 33%, "India 6% is the next one down"; "They love Buicks in China—apparently it's the only reason the brand is still around." His description was grounded in quantified terms, which also conveyed relative responsibility, using quantified and reductive "carbon" metrics. In short, CARBON made the "correct" course of action obvious—and also made it obvious that the current course was not the right one. CARBON enables this paradox and the frustration that it engenders.

Carbon Econotechnics

CARBON also enables an effortless transition between talking about models of climate, talking about climate politics, and talking about models of economic approaches to addressing the climate problem. Within CARBON discourse, it is easy to get the impression that "what should be done" and "what is being incorrectly done" is rather obvious. During a conversation in the regional lab about legislative inaction on climate in the U.S., one modeler simply stated that "there are well respected economists who've laid out plans for dealing with global warming and they've been basically ignored." Those plans for dealing with global warming come in several varieties (e.g. different permutations of cap and trade, carbon tax, etc.), and "carbon" is the crux of them all. The statement of the modeler implicitly makes this link. In other words, climate modelers and economic modelers who draft plans to address climate change are both operating within the discourse of CARBON.

These economic plans, aka models, are based on an ideal/idolization/assumption of "carbon" as countable, traceable, and calculable in such a way that it can be made subject to the rules of "the economy" (recall the discussion of "carbon" and "the economy" in chapter one). As Blok notes, with "carbon marketization… economic models are here being turned into practical empirical reality."[584] It is, of course, not a coincidence that "carbon's" foundational role in economic models parallels the role of $C_{dioxide}$ in climate models. This similarity is easily taken as a mere reflection of the "science." It is, however, much more than that; the foundational role of "carbon" in different spheres is a reflection of the dominance of CARBON in climate governance. The idea that solution/s to the climate problem can be straight-forwardly engineered through economic and/or technological projects will be described here as "'carbon' econotechnics." In short, "carbon" econotechnics is the model of the world that follows from CARBON discourse.

[584] Blok. 469.

"Carbon" econotechnics is a normatively grounded response to the warnings of climate models. Swyndegou similarly describes the dominant approach to addressing climate change as having been put in the hands of a "techno-managerial eco-consensus."[585] Similarly, Stephan and Lane's edited volume on "the politics of carbon markets"[586] is built around the premise that the work of addressing climate change has been "depoliticized," that is, relegated to a sphere of rather ineffective expert management and market-based approaches.

"Carbon" econotechnics has evolved in lock step with CARBON discourse. IPCC synthesis reports[587] have, over time, mentioned C_{word} on its own (i.e. excluding other permutations, such as CO_2, "carbon cycle," etc.) with increasing frequency. Overwhelmingly, when C_{word} is mentioned in this "pure" form, it is in the context of discussing potential technical solutions or in relation to economics, e.g., describing the emissions associated with national economies or the work of cap and trade programs.[588] Much like its presence in the lab, C_{word} in the IPCC reports arises with reference to what is to be done or what is not being done (but should be).

Economic models that propose to price, offset, tax, commodify (etc.) "carbon" have decarbonization (reducing the GHG intensity of an economy) as their goal. Although there are distinctions between the approaches, they can be grouped as belonging to a singular apparatus of "carbon" based economic models/programs/

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[585] Swyngedouw. 264
[586] Benjamin Stephan and Richard Lane, The Politics of Carbon Markets, (Hoboken: Taylor and Francis, 2014), http://ucsc.eblib.com/patron/FullRecord.aspx?p=1775352.
[587] These reports have been published in 1990, 1995, 2001, 2007 and 2014.
[588] See the section on "marketization" in chapter one.

proposals. “Carbon” functions simultaneously as a descriptive and normative device, with its normative/rhetorical power deriving from its “pure” powers of representation and in calculations. For instance, the “correct” carbon price (that which will influence behavior in the direction of conservation without destabilizing other aspects of the economy too much) is a normative, and subjective, albeit quite technical and precise calculation. A price “correction” is designed to influence the world, but based in measurement of the price of carbon offsets and credits on different markets, estimations of national carbon budgets and expenditures, etc. These models aim to ameliorate the climate problem (or perhaps make money in the name of doing so) through creating economic incentives that work with capitalism and through CARBON:

> Climate change and the uncertainty that it entails is seen as exploitable and imbued with potential profit based on the assumption that the more uncertainty or risk that the climate is worsening, the more profit.[589]

The idea of a unified, global carbon market or international regime eventually coming into being is the meta-model within which these others operate.[590] These plans would not effectively address the climate problem on an ad hoc basis—both the fundamental laws that govern markets and climate change would require “carbon” to be managed more-or-less globally (e.g. see the problem of “leakage” described in chapter three) for climate change to be effectively mitigated.

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[589] Dalsgaard. 91.

[590] This is the case even though carbon markets in their particularities are “fruits of the imagination of innovators in the wild [and] truly collective, distributed experimentation deployed in time and space, more or less chaotically,” as described by: Michel Callon, "Civilizing Markets: Carbon Trading between in Vitro and in Vivo Experiments," *Accounting, Organizations and Society* (2008). 538.

Commodified “carbon” does not represent $C_{element;}$ it represents transactions that are a rearrangement of how the market would “naturally” arrange $C_{element}$:

> carbon appears in this most recent commodity form rather as a kind of intangible or intellectual property, because what is traded is the right to produce or consume carbon via emissions rather than the carbon itself. Carbon is thus not an object or a commodity that is produced or consumed in any classical sense. As a basic element, carbon itself is really constant in nature…[591]

Put more simply, “carbon” embodies the concept of internalizing environmental externalities. Marketized “carbon” therefore fundamentally suggests questions with regard to the structure of global political economy, the assumption that economic growth is an imperative, and the character of the relationship between capitalism and nature.[592] On the one hand, “carbon” is designed to function as a corrective to capitalism, and therefore implicitly critiques it. On the other hand, “carbon” inherently functions according to market logic that suggests that capitalism can be redeemed.

“Carbon” is an important economic object; like money, it represents material transactions, and both “carbon” and money *real*ize a logic of calculability within the economy. “Carbon,” however, is the flip-side of the money coin. Whereas money is notably abstract, representing the immaterial concept of value, “carbon” ostensibly compensates for money’s shortcomings of abstractness and immaterialness. In other words, “carbon” is supposedly representing that which the economy heretofore did not account for: the invisible dispersed costs that accompany the visible, focused

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591 Dalsgaard. 82.
592 Many others, of course, explore the relationship of capitalism and nature in depth. E.g. see, John Bellamy Foster, *Marx’s Ecology: Materialism and Nature* (NYU Press, 2000).

benefits of fossil energy. “Carbon” achieves this feat, on paper, so to speak, through largely the same diffuse process and principles of efficient resource allocation and “self-interest” that govern money in the economy. Unlike the role of money in economic transactions, it is difficult to get “carbon” to cooperate with “carbon” econotechnics. Money itself represents something abstract—value—and becomes real through its role in practices and forces in global political economy. Economic “carbon,” however, is supposed to parallel flows of C_{GHG}.

> Carbon trading involves the creation of a sphere of negatives or virtuals, which shadows the world of production, circulation, and consumption (cf. the term “offset”). Carbon (in the guise of CO2) gains exchange-value by virtue of not being produced, circulated, or consumed[593]

If it does not sufficiently do this, it is merely money in sheep’s clothing.

In “carbon” econotechnics, CARBON is the foundation of the model for how to fix the climate by forcing the internalization of that which the market would otherwise externalize. In other words, CARBON leave largely intact the practices and structures that produced the climate problem. This model of how to fix the world works beautifully in “model world.” I occasionally heard climate modelers use this term, which they explained as a reference to the internal consistency of a given model, which might not hold once more “external” factors were introduced. Despite the pervasiveness of CARBON discourse, i.e. the popularity of its assumptions, there is ample evidence (cataloged in chapter two) that these assumptions do not hold

[593] Dalsgaard. 91.

universally.[594]

The irony that remains is that "carbon," so closely associated with "reality," seems to arrange "reality" in a manner that is utterly discordant with the linear conception of modern time and the particularistic conception of modern space:

> The equation of real and imaginary reductions also requires that ''what would have happened'' in the absence of carbon credit sales be determinate and quantifiable in the same way that CO2e reductions under a cap are determinate and quantifiable. Counterfactual history, that is, must be given the same epistemic status as actual history and political debate about alternative futures recast as disputes about the correctness of technical predictions.[595]

With offsets, therefore, the existence of Nominalist "carbon" can be oddly conjectural and unobservable.

Economic models of "carbon" have many ontological aspects in common with climate models.

> The carbon credit seems to make different forms of emissions equal, but it also makes virtual or potential future actions equivalent to real actions, ascribing value to something that has not happened yet and may never happen.[596]

Data from hypothetical futures are produced by models, and then made quasi-real in the present. The contingent data of climate models and the commodification of potential future actions have an underlying Scholastic logic—they are produced by applying general principles of atmospheric dynamics or supply and demand—but take a form that is particularistic—a numerical result of model output representing precipitation at a particular latitude and longitude, or a piece of paper representing a

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[594] Whether and to what extent climate action would improve if the assumptions of CARBON were significantly more widely accepted is a worthwhile but tangential question.
[595] Lohmann, "The Endless Algebra of Climate Markets." 106.
[596] Dalsgaard. 91-92.

carbon credit. That these particulars are derived from general knowledge, but take a particular form, can help us understand the reason that "reality" is so often invoked in these spheres: these items are at once partially real and partially unreal, or, rather, they do not conform neatly to either a Scholastic or a Nominalist ontology, but combine elements of each.

CARBON follows in the scholastic/determinist mode; it is an idealized representation of how the world "should" work, and it is accompanied by the implication that humans should aspire to this ideal by enacting projects designed in its image. Yet, the (inevitable?) contingencies that arise to challenge deterministic visions should give us pause that CARBON paves the path to a climate solution.

> carbon credits and carbon permits are thus *ideally directly* [emphasis added] rooted in the material fluctuation of carbon between relatively immobile storage in natural deposits and circulation in the atmosphere [597]

In other words, "carbon" econotechnics works under the assumption that particular (Nominalist) C_{GHG} (as opposed to the concept of C_{GHG} in the more abstract, Scholastic sense) can be represented reasonably well *in general*—e.g. not simply by Volkswagon, but also Hyundai, Mexican foresters, the Chinese government, etc.

[597] Ibid. 82.

Conclusion

The tension between data and models pervades climate politics, and invigorates contention, despite the CARBON consensus. CARBON is a discursive presentation of a model—*the* model—of how to fix the world. That model is modernist, emphasizing reductive, quantifiable approaches to determining responsibility and reorganizing energy systems, in accord with the dictates of the progress of knowledge. The model of how "carbon" should work in the world does not recreate the world in its image, though it is a noteworthy force in the world nonetheless. As chapter two argued, the rubric of carbon management, as the suggested (a)political recommendation that derives from the models, has been an ineffective approach: CARBON prescribes a model for conducting climate politics that has not undergone the same peer-review process as climate models.

Climate change activists assert that the "carbon" imperative is self-evident—a rather universal/determinist proposition—but given that it is not evident to everyone, it is not self-evident at all. The assertion of self-evidence or obviousness makes an argument for what should be done by making the case that it is the only rational thing to do. I.e., it communicates that this is a matter of necessity, more so than choice. The position that the "carbon" imperative is not self-evident seems to imply that humans have a choice in the matter, but the only choice that consensus climate science leaves is between deciding that the science is wrong, or, if it is right, that humans may doom themselves by not following the "carbon" imperative. In any case, the meaning and limits of human agency (and, with it, modernity) are thrown into doubt.

It is difficult to determine what man is if not some mix of God and nature. Does the human have free will or not? I.e., is the human entirely natural (functioning through necessity) or also somewhat divine (i.e. having free-will and agency)? This question can also be posed in another form: do humans function according to natural selection or transcend it? Climate politics, with its conflict over whether it is necessary or ill-advised to "intervene" in "carbon" flows, comes from the same mold. The divisive dynamic of climate politics replays this tension between natural necessity and free will. For example, for climate change believers "carbon" is deployed as an assertion that the relationship between man and nature is not as it needs to be if we are to avoid the disaster that climate change will bring; climate deniers are apt to view the "carbon" regulation that believers say is necessary as an assault on free will. Humans seem to have caused climate change neither out of necessity nor free will. *Must* they solve it (out of necessity)? *Can* humans solve it? (I.e. do they have the agency and free will to do so?) Underneath this division are unresolved metaphysical disputes about whether our fate has been determined and whether we can and should intervene in the future.[598]

That question opens up another line of inquiry regarding the nature of collective agency. This is, in other words, fundamentally an issue of governance. It is

[598] Gillespie argues that more fundamental to modernity than reason is its notion of time, which differs from ancient Christianity's circular conception of time. In order to envision that the lot of humanity could be improved through the application of reason and knowledge to it, time had to be thought of as something linear and infinite.

easier to make the case that individuals have agency, as opposed to collectives of individuals. It is difficult to make the case that collectives have agency without undercutting, to some extent, the agency of individuals. Climate change, however, seems to force this question. One way to conceive of human collective agency is with government--i.e. the creation of a singular entity to represent and act in the name of the collective (and this line of thought then brings all the familiar questions about which types of governments are best, just, democratic v. authoritarian, etc.). Yet, humans have brought about anthropogenic climate change. Either humans have done so by exercising collective, unguided agency, or anthropogenic climate change is an enormous, unintended consequence of lots and lots of individual agential actions. It is easy to make either case, but only up to the point that climate change, and the human role in it, became widely known. Now that it is widely known, and the trend of human contributions to it continues, are we facing human agency devoid of intentionality? We do not seem to know how to help ourselves.

"Carbon" is associated with metaphysical crisis through its association with climate change, just as modernity, according to Gillespie, originated in a metaphysical crisis that was waged between Scholasticism and Nominalism. In the case of "carbon," however, climate change reopens this old wound that had never quite healed. The contentiousness of climate politics has its roots long before modern knowledge of climate change. The provisional order that modernity established in response to metaphysical crisis is again being challenged by the (meta)physical crisis of climate change.

The Contemporary Carboniferous

The situation we're creating for young people and future generations is that we're handing them a climate system which is potentially out of their control. […] We understand the carbon cycle: the CO2 we put in the air will stay in surface reservoirs and won't go back into the solid earth for millennia. What the Earth's history tells us is that there's a limit on how much we can put in the air without guaranteeing disastrous consequences for future generations. We cannot pretend that we did not know.[599]

James Hansen, NASA scientist and climate activist

When Are We?

The concept of the Holocene was introduced in 1885.[600] One of its defining characteristics is warming after the last great ice age. The beginning of the Holocene is placed at 10,000-12,000 years ago—a time that corresponds with the beginning of the Neolithic period of human prehistory, which began in the Middle East approximately 10,000 years ago as well. The Neolithic "revolution" includes the development of settlement agriculture, livestock domestication, and other changes that mark what is easily characterized as a significant shift in the relationship between what moderns would later come to describe as "humans" and "nature." For instance, in his "Cultural History of Climate," Behringer notes that with the beginning of the Holocene and Neolithic, "*Homo sapiens sapiens* began to make massive incursions

[599] Severin Carrell, "Nasa Scientist: Climate Change Is a Moral Issue on a Par with Slavery: Prof Jim Hansen to Use Lecture at Edinburgh International Science Festival to Call for Worldwide Tax on All Carbon Emissions," *The Guardian*, April 6 2012.
[600] Note that, as referenced below, this year comes after many of the debated start points for the Anthropocene.

into nature, turning it into a cultural landscape."[601] In short, this period is understood as the beginning of a rift between nature and human (via culture). The parallels with "the Anthropocene" –a concept itself ironically proposed as the geological break with the Holocene—are obvious.

"The Anthropocene" embodies the proposition that collective human agency has mounted an attack on a now retreating nature. Some of the term's most strident cheerleaders argue the "Great Acceleration" of human impacts since around 1950 "is reaching criticality," adding "[h]uman activities have become so pervasive and profound that they rival the great forces of Nature."[602] Ecomodernists have adopted the term and added a twist: the possibility of a "good, or even great, Anthropocene." In this vision, "humans use their growing social, economic, and technical powers"[603] to do no less than end material poverty, "re-green" the earth, and help "developing countries [to] achieve modern living standards."[604] Moreover, these achievements are to be fulfilled through intensifying farming, energy extraction, forestry and human settlement, so that human (development) is "decoupled" from (its impact upon) the environment.[605] Both of these conceptions of the Anthropocene can be read as elaborate attempts to maintain the modernist understanding of the world as divided between humans and nature, while keeping human agency at the fore.

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[601] Behringer. 39.
[602] Will Steffen, Paul J. Crutzen, and John R. McNeill, "The Anthropocene: Are Humans Now Overwhelming the Great Forces of Nature?," *Ambio by the Royal Swedish Academy of Sciences* 36, no. 8 (2007). 614.
[603] Asafu-Adjaye et al. 6.
[604] Ibid. 15.
[605] Ibid. 7.

The "Anthropocene debate" has been occupying geologists as an ostensibly technical matter for more than a decade. The term was first popularized in 2000 by Paul Crutzen, a Nobel-winning chemist, and Eugene F. Stoermer, a marine scientist.[606] In 2011, Crutzen (and a different co-author) reiterated the argument that planet Earth "is being anthroposized at high speed."[607] The International Commission on Stratigraphy has been considering a proposal, since 2008, that the official name of the current geological epoch, which falls under the Holocene for now, should be changed to the Anthropocene. In the meantime, however, the term has come into regular usage by many scientists as well as non-scientists, inspiring rapt interest in pockets of the "high end" press[608] and academia,[609] and is remarkably uncontroversial.[610]

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[606] Paul J Crutzen and Eugene F Stoermer, "Global Change Newsletter," *The Anthropocene* 41 (2000).

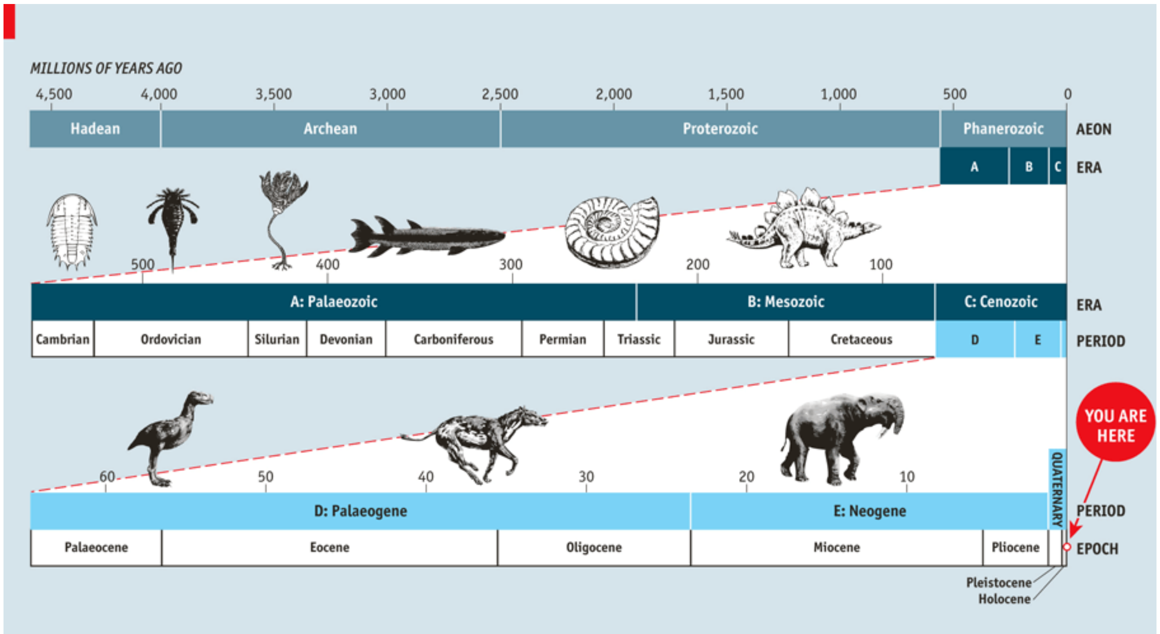
[607] Paul J. Crutzen and Christian schwägerl, "Living in the Anthropocene: Toward a New Global Ethos," http://e360.yale.edu/feature/living_in_the_anthropocene_toward_a_new_global_ethos/2363/.

[608] For example: Elizabeth Kolbert, "The Climate of Man I & II," *The New Yorker*, April 25 2005. Also: The Anthropocene: "The Anthropocene: A Man-Made World (Science Is Recognizing Humans as a Geological Force to Be Reckoned with)."

[609] For example: Latour, "Agency at the Time of the Anthropocene." Also: Dipesh Chakrabarty, "The Climate of History: Four Theses," *Critical Inquiry* 35, no. Winter (2009). As well as: Donna Haraway, "Anthropocene, Capitalocene, Plantationocene, Chthulucene: Making Kin," *Environmental Humanities* 6, no. 1 (2015).

[610] Consider, for example, the title of a recent article co-authored by over thirty experts in environmental science and policy, which advocated for dramatic and rapid structural change in global environmental governance: Biermann et al.

Image 10) Geological Schema[611]



As scientific terminology, the designation conveys that humanity has left such a large mark on the ecosphere that it is – or "we" are - the epoch's most noteworthy material force. This is as opposed to traits distinguishing other geologic ages, e.g., the beginning of photosynthesis, the emergence of multi-cellular life forms, or an ice age. In other words, the term Anthropocene communicates that the distinguishing characteristic of this age is that humanity has become a force "of" (or *on*) nature. Geologists are currently busy debating and gathering evidence that will be deployed to more precisely define the new epoch's parameters,[612] if and when the designation

[611] Reprinted from *The Anthropocene: A Man-Made World.* http://www.economist.com/node/18741749

[612] Earlier in the Anthropocene debate, the English industrial revolution was often suggested as a starting-point. Consensus now seems to be converging around 1950, which corresponds

becomes a scientific fact.[613] The Anthropocene configuration of the relationship between man and nature maintains modernity's distinction between nature/man/God while also, ostensibly, refining or even rearranging their relationship *vis a vis* one another. The designation maintains the ontic superiority of nature—as this is a materialist account—while placing agency (i.e. God given will) with humans. In brief, a primal, modernist vision underlies the designation of the current epoch as the Anthropocene.

The conceptions of agency in the Anthropocene conversation are a close cousin to those that trouble climate politics. The notion of anthropogenic climate change highlights the agency of humans in the present and relatively recent past to shape the climate of the future. The causal arrows between climate and human change, however, point in both directions. The scientific narrative of climate change asserts that the phenomena *will* affect humans monumentally in the future, through forecasted climate impacts. Simultaneously, the account also emphasizes the agency of humans in relation to climate, as humans are causing climate change (through carbon emissions). The narrative implies that climate *should* (but has not sufficiently been able to) inspire human action to remediate and mitigate climate change, because its existence enables human knowledge of its "reality," and that knowledge compels

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more closely to radioactive markers left by the first atomic bombs and the "Great Acceleration." Climate change, plastics, and the proliferation of domestic chickens, among other things, are commonly referenced as other physical markers, i.e. "golden spikes."

[613] Damian Carrington, "The Anthropocene Epoch: Scientists Declare Dawn of Human-Influenced Age," *The Guardian*, August 29 2016.

human action.[614] Therefore, with enough convulsions, it would seem that the causal arrows might do more than point in different directions, but to wrap in a figure eight. Attempts to sum up the causal relationship/s succinctly succumb to awkward grammar: with its politicization, climate change is/will-be/should-have-been influencing human behavior, and humans have been, are, and should-not-be influencing the climate.

The Climatic Disruption to Modern Mastery

> *To deny that global warming is real is to deny that humans have become geological agents, changing the most basic physical processes of the earth. For centuries, scientists thought that earth processes were so large and powerful that nothing we could do would change them. This was a basic tenet of geological science: that human chronologies were insignificant compared with the vastness of geological time; that human activities were insignificant compared with the force of geological processes. And once they were. But no more.*[615]
>
> Nancy Oreskes, Historian of Science

The Anthropocene approach to environmental problems gives a conflictual account of the relationship between humans and nature. Crutzen's rationale for the

[614] It is difficult to give serious consideration to the counterfactual proposition that science never came to produce knowledge of climate change. In other words, imagine that anthropogenic climate change existed at its present, projected magnitude without any human knowledge that this was the case. Given the apocalyptic implications of the climate science that is known, could humans—especially the humans of the more extreme future that is projected—be unaware of the crisis that faced them? It is not coincidental that processes of capital and knowledge accumulation are coterminous with GHG accumulation in the atmosphere—the atmosphere is responding to a socio-natural context that includes the capacity to discern atmospheric changes.

[615] Naomi Oreskes, "The Scientific Consensus on Climate Change: How Do We Know We're Not Wrong?," in *Climate Change: What It Means for Us, Our Children, and Our Grandchildren.* , ed. Joseph F.C. DiMento and Pamela Doughman (MIT Press, 2014). 138.

new designation goes beyond the scientific argument that “human dominance of biological, chemical and geological processes on Earth […] is already an undeniable reality,” to an explicitly normative argument that humans have “clumsily” been “taking control of Nature’s realm, from climate to DNA,” and acting as “rebels” against “a superpower we call Nature.” In short, the assertion that we are in the Anthropocene serves mainly to tell us something we have known for a long time – that the environment is cause for human concern, due to how it has been treated by humanity.

Crutzen’s campaign for making the Anthropocene official science, in other words, is for explicitly political purposes. He no doubt falls into the category of “intellectuals of the environmental movement [who] have long thought that their appropriate role was to articulate a grand refusal on behalf of the earth.”[616] Crutzen suggests that:

> teaching students that we are living in the Anthropocene, the Age of Men, could be of great help. Rather than representing yet another sign of human hubris, this name change would stress the enormity of humanity’s responsibility as stewards of the Earth. It would highlight the immense power of our intellect and our creativity, and the opportunities they offer for shaping the future. […] The awareness of living in the Age of Men could inject some desperately needed eco-optimism into our societies.[617]

This passage puts human agency at the center of environmental politics – tying the planet’s salvation to human action while also blaming human agents for nature’s endangerment. This self-contradictory human role undermines the political argument;

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[616] William Chaloupka, "There Must Be Some Way out of Here: Strategy, Ethics, and Environmental Politics," in *A Political Space: Reading the Global through Clayoquot Sound*, ed. W. Magnusson and K. Shaw (University of Minnesota Press, 2003). 74.
[617] Crutzen and Schwägerl.

it makes as much sense to claim that result of putting the Anthropocene in textbooks would be eco-pessimism as eco-optimism. As Chaloupka notes, the tendency of greens to approach nature as “other” leads them into a political paradox in which “[c]ulture is inevitably cast as nature’s adversary and simultaneously as its only hope.“[618] In other words, the Anthropocene terminology regurgitates the classic elements of environmental discourse that have not served green goals well.

“Anthropocene” re-inscribes the delineation between human and nature that is inherent both in the definition of environmental problems, and the difficulty of solving them. Therefore, it makes little sense to assume that repackaging environmentalism’s guiding narrative of nature’s victimization at the hand of human culture, through renaming this phenomena “the Anthropocene,” will be more politically effective. The Anthropocene message preaches to the environmentalist choir, while constantly reminding it of the congregation’s sinfulness. From this perspective, “Anthropocene” is the latest installment of a hackneyed message of environmental advocacy that is stuck in the nature/culture dichotomy.

This founding environmentalist dualism has its roots in modernity. The relationship of man and nature that modernity outlines has it that not only does man study nature, but a primary aim of this investigation is to bring nature under “his” control (e.g. in the form of technological “mastery” and property). The modernist conceit of human mastery over nature, through knowledge, however, is left

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[618] William Chaloupka, "The Irrepressible Lightness and Joy of Being Green: Empire and Environmentalism," in *Empire's New Clothes: Reading Hardt and Negri*, ed. Jodi Dean and Paul Passavant (New York: Routledge, 2003). 200.

flummoxed by the continued deterioration of the climate in the face of human knowledge of, and attempts to fix, the problem.

That is, given that the problem of climate change is defined by anthropogenesis, a number of agential quandaries arise. On the one hand, the atmosphere is understood to function according to universal, physical laws that govern matter. On the other hand, it is human agency to alter inputs into the physical climate system that is deemed to matter. For the former, deterministic and un-agential proposition to hold, the latter, contingent and agential proposition must also assume that human (physical) agency depends on immaterial and intentional (therefore transcendent and Godlike) agency. That is, (human) agency is deemed to be immaterial, whereas the climate system is constructed as lacking agency, and simply subject to the combination of inputs and universal laws that govern it. Yet, the narrative that climate change is inevitable if humans do not reform themselves—which they surely must but do not seem to be able to do—also sends the message that humans seem to have little ability to exercise intentional agency in this regard. In other words, the aura of inevitability surrounding climate change is discordant with the message of climate activists that humanity can save the climate (and with it, themselves.)

This evokes—recalling themes from chapter four—the larger, metaphysical question of whether or not fate has been determined. Whether the universe is contingent – i.e. whether the future can be changed – is rooted in a question about our own mortality and whether we have any control of it. This question, in turn, cannot be addressed without entering the unresolved territory of the relationship between God, man and nature. The discrepancy between Hobbes and Descartes on this configuration is illustrative. Descartes argued that humans are natural *and* divine, stressing that they are both corporeal and incorporeal beings, with the tinge of divinity the source of human free will. For Hobbes, humans were solely natural beings who therefore operated out of necessity for the sake of survival. In other words, the fear of death – and, by extension, the imperative for survival and/or salvation – pervades conceptions of the future and who/what/whether it has been determined.

"Carbon's" new political role carries this tension wherever it goes. As a material entity, $C_{elelement}$ seems to be on the one hand subject only to determined laws; yet, on the other, it is seen as the entity that matters and will determine our un/decided future, and thus seems to be *the* conveyer of agency around the world.

The Contemporary Carboniferous

"Carbon" can symbolize nature's agency, as well as other agencies. For example, Carbon's agential ties are implicit in the message of Bill McKibben's *350.org*, which proffers that 350ppm of $C_{dioxide}$ in the atmosphere is the dividing line between a nature sufficiently-in-the-balance and environmental calamity. In that instance, "carbon" enforces "nature's" threshold. It is also the case, however, that the "carbon" that found its way into the atmosphere from fossil fuel emissions fifty years ago would seem to give a sustained (or perhaps resurgent) agency to human emitters from that time. Thus, through the threat of climate catastrophe, the agency of humans in the past, and nature in the future are joined (along with other agencies) to exert a force on the planet and its inhabitants now. Therefore, regardless of who or what coerces the movement of "carbon" (or when), it is the entity that convinces "carbon" to move (perhaps even the "carbon" based molecules themselves or their component atoms) that is – momentarily – understood to be agential. Therefore, "carbon" illustrates that who or what exercises agency, and how, is an open question (as opposed to the ontological premise of the Anthropocene that humans are the locus of agency).

The root of Anthropocene, *anthro,* asserts humans are at the center of the present moment. This dissertation concludes with the proposition that it is not the agency of humanity, but "carbon" that best represents and helps us re-think this era's political struggle against "anthropogenic" climate change. Therefore, this conclusion proposes an alternative periodizing moniker for thinking about climate politics: the Contemporary Carboniferous.

Between 300 and 360 million years ago, as the continent Pangaea was coming together, the earth was heavily forested, inhabited by multitudes of amphibians, and experiencing climatic changes that brought about a minor marine extinction event. Those forests would eventually become large deposits of coal, hence the name of the period, "Carboniferous," (from the Latin *carbo* – coal, and *ferre* –to carry). The Contemporary Carboniferous describes the socio-natural epoch marked by rapid shifts in "carbon" flows, through and regardless of human un/conscious in/action. In short, Carboniferous is the name of the period when great quantities of $C_{element}$ became part of the ground: the Contemporary Carboniferous is the epoch that has let much of that "carbon" out.[619] Significantly, this is not merely a physical phenomenon. "Carbon" has also come to be known as fundamental to how the world works, and CARBON takes part in making the world work as it does. In the Contemporary Carboniferous, as agency moves through "carbon" and CARBON, the scientifically revealed urgency of climate change mounts a revolutionary challenge to the present socio-natural global order. One way to interpret climate change knowledge, then, is as a *real*ization of material agency on a monumental (and miniscule) scale.

The label Anthropocene implicitly insists that material ("nature") and social ("human") worlds influence one another. It does so, however, at such a grand scale (both temporally and spatially) that it fails to suggest much of a way to understand how the material and the social interact at non-grandiose scales. The Contemporary Carboniferous, by contrast, assumes that the material and social have never truly been separate. "Carbon" serves to illustrate a specific pathway of connection between humans and the environment that serves also to blur the line between the two—or rather, between nature/man/God by highlighting the rift in temporal and spatial

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[619] Carboniferous and Anthropocene are not perfectly commensurate in a technical sense: the Carboniferous is/was a "period," whereas the Holocene is a subset, an "epoch" of the later Quaternary period [image 10, page 293]. If the Contemporary Carboniferous were to be officially proposed as the name of a new epoch, in place of the Anthropocene, the –cene suffix would need to be used. "Carbonocene," however, is less aesthetically appealing, and does not convey the links between the current situation and the previous Carboniferous period as nicely.

scales.[620] In so doing, "carbon" cuts to the core of the issues of agency, and particularly the tension between free-will and necessity, that are crucial to understanding the ontological dynamics of climate politics.

From this perspective, the intractability of climate politics can be understood quite differently than is typically the case. Chapter three's analysis of climate discourse concluded that beneath the outward environmentalist crusade to solve the problem there is a deep-seated yet for the most part unacknowledged worry that climate change is not destined to be solved. Rather than asking how to solve climate change, and why this has not yet happened, it may be more worthwhile to consider whether an *acceptable* solution to climate change exists, and whether the current socio-natural order is acceptable. Put differently, we could consider "what would we like to do?" rather than "why aren't we accomplishing what we must do?" That is, thinking through the Contemporary Carboniferous, rather than CARBON, could bring climate change to the realm of politics.

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[620] Chakrabarty emphasizes that climate change requires thinking at multiple scales and timeframes simultaneously as creating cognitive rifts: Chakrabarty, "Climate and Capital: On Conjoined Histories." 3.

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