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Should Naturalists Believe in the Anthropocene?

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INTRODUCTION

Human beings are not separate from nature but are a part of it. It has become impossible to do research in the interdisciplinary domain of environmental studies, broadly construed, without encountering this truism. The idea is not new, but it has been given a new life in recent years with the help of a new vocabulary, and the general sense of urgency that something needs to be done to combat anthropogenic climate change. Aldo Leopold famously argued that humans are not 'conquerors' but 'plain citizens' of an integrated biotic community (Leopold, 1981). More recently, many commentators have spoken of the need to treat human and natural systems as integrated 'socio-ecological systems' (cf. Liu et. Al. 2007, Ostrom 2009, McGinnis and Ostrom 2014). Perhaps the most telling neologism was famously proposed by Paul Crutzen (Crutzen, 2002), who argues that the world has entered a new geological era, the 'Anthropocene', a time and place where the activities of a single species have geophysical impacts on a scale recognizable to geologists.

The Anthropocene, and the corresponding 'anthroposphere' (Baskin, 2015) that we inhabit, seems well established as an ontology of integrated natural and social systems. There is no denying that human beings are part of a larger biosphere, that human systems causally interact with natural systems at the geological scale, and that the distinction between 'natural' and 'social' systems is without any ontological ground, but is rather (at best) a useful analytical distinction. Yet despite the consensus that we live in an integrated natural and social world, the Anthropocene concept, and the related idea that the earth is a bounded socio-ecological system,

has generated a great deal of controversy (Malm and Hornborg 2014, Smith and Zeder 2013, Baskin 2015, Brand 2016, Stojanovich et al, 2016). The issue isn't really with the ontology, but with the requisite epistemology, or epistemologies, mustered to grapple with the ontology. The Anthropocene paradigm has become a breeding ground for methodological turf wars, reminiscent of the 'science wars' (Brown, 2004) of the 1990's, pitting natural scientists against theorists in the social sciences and humanities. And no wonder: the Anthropocene is a hybrid epoch, in which the actions of social agents have impacts that are crucial to understanding, let alone steering or influencing, earth's geological history. Conversely, it has never been more obvious that human beings ignore the findings of the natural sciences, for example the discovery of biophysical limits or planetary boundaries, at their own peril (Brundtland, 2012; Rockstrom, 2009).

Given the transdisciplinary challenges posed by the Anthropocene, it is perhaps disappointing yet unsurprising that the arguments about its meaning and significance have taken place along disciplinary lines. Natural scientists bemoan the lack of input from the social sciences with respect to clarifying, modelling, explaining, and even predicting or steering human systems that impact the biosphere. For example, Palsson et al (2013) suggest that 'the social sciences and humanities need to analyze emerging societies in order to determine the extent to which and the way in which they appear anthropocenic in their values, culture, institutions, and cosmologies, in ways that distinguish them from past societies' (Palsson et al., 2013, 8). Interestingly, the authors do not distinguish between the humanities and social sciences. Yet the implication seems to be that, once identified, the anthropocenic 'bad apples' have to be steered into more sustainable trajectories, presumably with the help of technocrats trained in the social sciences

This approach has met with a combination of scorn and condemnation from authors on the humanistic side of the sustainability issue. Many authors object to the subsumption of human categories like agency, ideation, narrative, values, and power under the umbrella of a natural scientific worldview (Malm and Hornborg 2014). This 'naturalistic' approach is not only wrongheaded, the argument goes, but has potentially disastrous social consequences (Descola, 2013). It risks justifying top-down, technocratic, 'earth management' approaches to social control, couched in the language of crisis, thereby undermining democracy. It ignores and perpetuates inequality and power asymmetries, and reinforces a modernist managerial and technophilic approach, ignoring the historical irony that this approach was itself championed by the main perpetrators of the current crisis.

This article critically examines the Anthropocene concept not on political grounds, but on normative epistemic grounds. Like other commentators, I wish to cast doubt on the feasibility of 'socio-ecological systems' management, construed as a social transformation project, when that project is given an explicitly natural-scientific justification. But my analysis is nevertheless naturalist in its orientation. Drawing on the tradition of pragmatist analytic philosophy of science, I wish to argue that there is real analytic work to be done in clarifying or even debunking the Anthropocene concept, but that this work cannot begin until we achieve some measure of epistemological clarity about its use. Why do we believe that the word 'Anthropocene' is an appropriate designator to describe the current crisis? Those of us who subscribe to the kind of philosophical naturalism described by W.V.O Quine (1956, 1957), and elaborated by Hilary Putnum (1982), have reason to be skeptical that we are indeed living in an Anthropocene. This is so despite the truism regarding the integration of natural and social systems identified at the beginning of this paper. Philosophical naturalists typically subscribe to a

certain set of epistemic or cognitive values, and employ these values to determine their ontological commitments. Naturalists ought to stick to belief in those things recommended by their values for belief, and the Anthropocene epoch is not so obviously recommended.

The second goal of this paper is to attempt to defend a hybrid approach to assessing value and transforming the unsustainable status quo. I wish to suggest that the humanistic disciplines should be allies of the natural scientific community for the purposes of addressing climate change, rather than pitting themselves in opposition to the natural sciences. The reason is simple: while the ontology of social-ecological systems is unified, the systems of knowledge generation required to understand these systems are not. Social processes are not understood by social scientists in ways that bear close analogy to the understanding of natural processes in the natural sciences, and it is unclear that they should aspire to be. One implication is that expert input from the social sciences, at least in the current state of development of these sciences, does not provide a basis for technocratic social management strategies analogous to the expert input of natural scientists in the domain of natural processes. The present argument therefore provides an epistemological account of the entirely appropriate resistance in the literature to an integrated natural-social scientific management paradigm for socio-ecological systems. Articulating a sustainable social niche for scientific research that is both rigorous and democratic is a necessary first step for sustainable change. This means abandoning any pretense that social processes can be effectively understood using the tools of the natural sciences, or that social processes have any hope to be sustainable if they ignore or even demonize the important work done by natural scientists.

In the first section, I describe the kind of naturalism I wish to advocate, and review some the work in the philosophy of science literature to clarify and tease out those epistemic values that

are rightly prized by naturalists. In the next section, I turn to a defense of the role of epistemic values in justifying scientific belief, and suggest that the application of these values specifically to manage social processes is problematic. In the last section, I briefly consider the implications of this argument for the much-discussed Anthropocene concept, and the role of scientific expertise in addressing our current environmental crisis.

WHAT IS PHILOSOPHICAL NATURALISM, AND WHY IS IT SOCIALLY RELEVANT?

We are inclined to believe what scientists say about their own work, and to trust the methods whereby scientific consensus is reached. In an appropriately defined domain of applicability, there is no denying the epistemic authority accompanying work in the natural sciences. I take it as granted that there is a domain of legitimacy for the natural sciences, although its social importance and relation to the social sciences are contestable on multiple fronts (Funtowicz and Ravetz, 1993, Little 1991, Kitcher, 2011). Part of the task of this paper is to help clarify this domain of applicability. The general view that science is a sound method for reaching conclusions about what there is, and provides an effective and trustworthy means for finding out, is called philosophical naturalism.[1] In this section I wish to review and defend a moderate naturalist position, one that I think is implicit in the work of most natural scientists, and one that looms in the background when scientific expertise is called upon to help address pressing social concerns. The epistemic authority of the sciences is of course a two-edged sword: authority is potentially coercive, privileged, and open to abuse. For this reason alone, it is worth examining the epistemic grounding of the sciences and the values it represents and codifies in more detail,

[1] There are of course many flavours of naturalism, both ontological and methodological. Naturalism should not be confused with scientism, the more extreme view that science is the *sole* legitimate means of seeking explanations. A naturalist may grant that the sciences do not provide answers to all meaningful questions.

to see if these epistemic norms withstand scrutiny. But our primary motivation in this section is to clarify the domain of applicability of natural scientific methodology, by making more explicit the values that undergird its claims to legitimacy. I will then turn in the next section to the applicability of these values in the social sciences.

Philosophical naturalism evolved historically as part of a larger re-examination of the legacy of the positivist philosophy of science which dominated in the first part of the twentieth century. Many philosophers of science rejected the positivist idea that scientific theories are essentially nothing but tools for describing and predicting possible experiences, whether in everyday life or in the laboratory. This positivist creed was based on a commitment to empiricism, the general epistemic attitude that all legitimate knowledge claims must be derived from experience, combined with the observation that many everyday concepts, and even some arcane scientific concepts like 'electron', refer to things that cannot be directly observed. In the positivist framework, such unobservable objects and concepts were to be replaced or reduced to systems of sentences involving reference only to directly observable phenomena. Naturalism emerged from the predictable failure of this positivist project, as an attempt to capture what was right in it, namely the attempt to provide a foundation for scientific knowledge, while rejecting the extreme empiricism of the positivists. A major driver of this criticism was the observation that actual scientists (usually physicists in the literature) took themselves to be describing a real domain of objects that were nevertheless not directly observable. Philosophers like W.V.O Quine and Hilary Putnam agreed with the positivists that clarifying the epistemological and ontological presuppositions of scientific theories is an important endeavor. But they argued that when it comes to clarifying the ontology and epistemology of the sciences it is essential first to ask the scientists themselves what it is they take themselves to be doing, rather than imposing a

simplistic empiricism as the sole criterion of scientific belief commitment. Only when we understand scientific practice in the way that scientists do can we hope to make sense of that practice philosophically.

A naturalist, broadly construed, could therefore be defined as someone who believes in two propositions. First, one of the primary tasks of philosophy is to evaluate the philosophical commitments, both ontological and epistemological, of the sciences by examining actual scientific practice. Second, the ontological and epistemological commitment of scientists, as revealed by scientific practice, are to be taken seriously as candidates for our own ontological and epistemological commitments. This definition is deliberately inclusive, as it is intended to be appealing to the vast majority of working scientists as well as philosophers of science.

Nothing has yet been said about whether anyone *should* be a naturalist in the sense defined above. The assumption is that the success of the sciences can be taken for granted, and that the primary task of the philosopher is to clarify the nature of this success. Given the urgency of our current climate crisis, and the ambiguous role that the sciences play both in contributing to and helping to steer us away from crisis, this seemingly reverential attitude seems outright irresponsible. There is nevertheless a rich naturalist literature devoted to clarifying the cognitive or epistemic values at play in the sciences. We can start to evaluate the usefulness of naturalism in the social domain by tracing some of these values explicitly and then asking whether they have any traction in domains outside of pure natural science where they are indeed taken for granted.

Even if they regard science as a rational enterprise, most philosophers and historians of science rarely tackle the question ‘what makes science rational?’ head-on, preferring to approach this diffuse question somewhat obliquely by studying the behavior of actual scientists, as well as

their decision processes. The construction of theoretical frameworks is a core element of scientific methodology, and a typical naturalist strategy is to tackle the problem of scientific rationality by examining the procedures that scientists use to adjudicate theory choice. Philosophers of science have long been concerned with the criteria scientists use to evaluate theories. Duhem ,1906 and Popper, 1935 are historical examples of such investigations. Kuhn, 1977 is an early discussion that explicitly casts such criteria as virtues, i.e, as reflective of shared cognitive or epistemic values. Since Kuhn, theoretical virtues have come to be viewed as a set of (perhaps evolving) epistemic criteria internal to science (cf. McMullin, 1983, Laudan, 1984, Lacey, 1999, Douglas, 2012).

What are the characteristics of a good scientific theory? Kuhn and other philosophers first identify consistency and coherence, both internally and externally, as basic conditions that any theory must meet. In Kuhn's words, 'within its domain…consequences deducible from a theory should be in demonstrated agreement with the results of existing experiments and observations' (Kuhn (1977), p.321). In the terminology of van Fraassen, 1980, this is the demand that a theory should aim for empirical adequacy. It is the mark of a good theory that its predictions are borne out by experiments, and the more precise the prediction, and the greater the agreement with experience and with other accepted theories, the greater our warrant for accepting the theory becomes.[2] We might also add as a corollary that a good theory should place demands on our experience, and the greater the demands, the more evidentiary a successful prediction becomes. For example, a theory that directs us to look for a new planet with the mass of three earths twice the earth's distance from the sun places greater quantitative demands on our experience than a theory that successfully predicts the existence of a planet of unknown mass and location. It is

[2] Clearly, this also implies that a theory must be testable.

also clear that a good theory should meet certain external demands of consistency. An acceptable theory is not only internally consistent and its predictions consistent with our experience, but ideally also consistent with other currently accepted theories. If a planet of a certain mass is found at a particular location, it should exert a detectable gravitational pull on neighbouring bodies of just the right magnitude, and our theory of the evolution of the solar system should in principle account for its size and location.

A good theory should also be good at explaining things. This means that the consequences of the theory should extend beyond the phenomena that the theory was initially developed to explain. Related virtues are simplicity and explanatory unity: a good theory is able to furnish a relatively simple explanation for a diversity of phenomena that might otherwise require separate and distinct theoretical descriptions.[3] This idea is sometimes captured by the term 'generality', which denotes the felt sense that a good theory is capable of finding general causal mechanisms (often, but not necessarily, causal laws) to explain and contextualize particular phenomena. This is certainly an important feature of arguably the two most influential natural scientific theories of the modern era, Newtonian physics and the Darwinian theory of evolution by natural selection. Regarding the principle of natural selection, Darwin writes:

> Now this hypothesis may be tested,- and this seems to me the only fair and legitimate manner of considering the whole question,- by trying whether it explains several large and independent classes of facts; such as the geological succession of organic beings, their distribution in past and present times, and their mutual

[3] For example, it is a virtue of Newton's physics that it adduces a single law to explain both terrestrial and extraterrestrial motion.

> affinities and homologies. If the principle of natural selection does explain these and other large bodies of facts, it ought to be received. (Darwin 1876, p. 9)

Newton prefigures this sentiment in the *Principia* when he writes that 'no more causes of natural things should be admitted than are both true and sufficient to explain their phenomena.'[4]

Kuhn identifies an additional criterion, clearly overlapping with the others, that he calls 'fruitfulness'. A theory 'should be fruitful of new research findings: it should, that is, disclose new phenomena or previously unnoted relationships among those already known' (Kuhn (1977), p. 322). A good scientific theory does not just describe existing phenomena or classes of phenomena. It should enrich our experience by encouraging us to explore new avenues of investigation, and prime us for the discovery of phenomena that might otherwise have remained hidden.

Kuhn's list is not intended to be exclusive or exhaustive but merely suggestive, and different theoretical virtues may sometimes conflict. Many of the disputes within the scientific community regarding theory choice can be framed as disagreements about the relative weight to attach to various theoretical virtues. Nevertheless, as a set, these virtues suggest that good theories possess great rational utility: adopting a certain set of theoretical assumptions is justified if doing so allows us to better negotiate the natural world. Scientific theories are incredibly useful tools for the prediction and explanation of natural phenomena, and they allow us to produce increasingly sophisticated interventions into the natural world. It is the *efficacy* of scientific theories, therefore, that warrants our adoption of a scientific approach to knowledge generation.

[4] This is Newton's famous 'first rule of reasoning'. The resemblance to Okham's razor is clear. See Newton 1999, pp. 794.

The efficacy of scientific knowledge is not primarily connected to theoretical understanding. It extends to the practical and social spheres, where technological advances connected to scientific research help to justify the social utility of scientific knowledge. Yet an equally important philosophical justification for taking interest in the scientific method is that it has profound unintended consequences in the realm of ontology. Judiciously applied, the methods of the sciences can compel belief in mechanisms and entities that even the practitioners of science are uncomfortable with, or lead to outright bewilderment and only reluctant assent. The social consequences of adopting a Copernican or Darwinian cosmology are profound and unsettling. The methodology employed by Newton, judiciously applied to the study of physical phenomena on the smallest and largest scales, with the help of advances in mathematics and technology, eventually led to the discovery of relativity theory and quantum mechanics. None of these theories makes comfortable bed fellows with the concept of free will. Quantum mechanics is perhaps the most empirically well confirmed physical theory ever developed, and yet there is surprisingly little consensus among physicists about what the world described by quantum mechanics is actually like. Here is a theory that is both universally recognized by physicists as correct, and yet whose basic ontology is hotly contested, a state of affairs that could not arise without an epistemology capable of compelling belief even when the consequences of the relevant beliefs are poorly understood. The epistemology of the natural sciences, as codified in a set of cognitive value commitments, is capable of fundamentally changing attitudes and commitments even when we don't know what the practical consequences might be.

Can something similar be said about the Anthropocene, given its theoretical connection to natural scientific methodology? Climate science does reveal in unambiguous terms that anthropogenic climate change is real. Human activity is certainly impacting the planet at the

geological scale. It is tempting to reason that like evolution, a heliocentric solar system, or quantum mechanics, the Anthropocene compels us to accept as real an uncomfortable ontology, the 'anthroposphere', whatever the social and political consequences. But I wish to argue that this temptation should be resisted. The Anthropocene cannot be understood entirely as a natural scientific phenomenon, although it can be treated as such for certain purposes. It is also a social phenomenon. This is not to say that it is a socially constructed concept like nationhood, but that it is constituted by natural causal processes that are irreducibly entangled with social causal processes. Understanding it requires that we understand the causal processes involved in bringing it about as social causal processes, while also viewing those processes as objectual, open to public scrutiny, and capable of compelling public assent. Social causes are not, however, easily subjected to such a naturalistic treatment.

CAN THE SOCIAL SCIENCES BE NATURALIZED? SHOULD THEY BE?

The Anthropocene exposes the competing priorities of the natural sciences, on one hand, and the social sciences and humanities on the other. It is an object of inquiry (or an ideological construct, depending on who is asked) that contains natural and social elements inextricably entangled with one another. Yet the tendency in the literature is to characterize the phenomenon as something entirely natural or as something entirely socially constructed. Natural scientists lament the lack of engagement with social scientists, but assume that social scientists will treat social processes using the same basic methodological tools that natural scientists recognize in order to explain the causal basis of the Anthropocene. Essentially this amounts to an admission that social mechanisms should be included in a complete ontology, accompanied by a 'doubling down' on the epistemological assumptions of naturalism. This approach fails to appreciate that the ontology recommended by natural scientific research is a product of the epistemological

commitments of the community of scientists, whom I have suggested are broadly naturalist. To extend the ontology to include social processes such as power, ideology, and agency would require a corresponding expansion of the epistemology of natural scientific research, one capable of treating human beings not merely as objects in an ecology, but as agentic subjects. It is not surprising then that many social scientists and researchers in the humanities have balked at the apparent suggestion that 'social processes' should be simply naturalized in order to create models of integrated social and ecological systems.

The array of attitudes expressed towards the role of economics and economic theory in promoting desirable social change is illustrative of this methodological impasse. It hardly needs to be argued that economics is at least a first among equals in the social sciences, for better or for worse, with respect to authority and legitimacy in the public policy domain for modelling social change. To take one example of this phenomonen, the Millenium Ecosystem Assessment recommends that '[g]reater use of economic instruments and market-based approaches in the management of ecosystem services' must be employed to fight ecosystem degradation ('Ecosystems and Human Well-Being' (2005), p. 21). This is despite the fact that what Herman Daly calls the 'neoclassical-Keynesian synthesis' associated with mainstream economics has been abundantly criticized on both normative and descriptive grounds.

For our purposes, the most illustrative criticism of so-called 'classical' economic theory is the naturalistic one coming from the ecological economics community. In its invocation of idealized rational agents or utility maximizers expressing their preferences in a closed market system, classical economics ignores the biophysical system that any economy is embedded within as an open subsystem:

> [T]he pre-analytic vision underlying standard economics (the neoclassical-Keynesian synthesis) is that the economy is an isolated system: a circular flow of exchange value between firms and households. An "isolated" system is one in which neither matter nor energy enters or exits- it has no relation with its environment, and for all practical purposes has no environment…it is as if a biologist's vision of an animal contained only a circulatory system but no digestive tract. The animal would be an isolated system. (Daly (1993), p. 813)

According to Daly, this idealization does not reflect a benign division of labour between economists and scientists, but is actually a critical error, since the economic system can no longer be treated as small in comparison to the larger ecology. On Daly's view, economics must be naturalized: the tools of climate science, systems theory, thermodynamics, and ecology are constitutive concepts in a viable economic theory. The discipline of ecological economics that Daly helped to pioneer takes the 'steady state' paradigm, an explicitly ecological (and ultimately physical) concept, as opposed to the standard economic 'growth' paradigm, as one of its starting points in the critique of classical economic theory (Georgescu-Rogen (1971), (1979), Daly (1993); though see also Spash (1999), (2011) for a critical historical analysis of the interaction between classical and ecological economics).Despite its invocation of fairly straightforward ecological constraints, the steady-state paradigm remains a minority position in the economics community. Whatever its intrinsic ethical and epistemic merits, and these are certainly questionable, classical economics is based on a vision of intentional human agency as purposive, rational, and in principle unbounded by biophysical constraints, a vision that is at odds with a

third-person naturalist reduction.[5] Speaking of attempts to naturalize reason in general, Thomas Nagel has noted that 'the application of certain concepts [of reason] from inside overpowers the attempts to grasp that application from outside and to describe it as a finite and local practice. It may look small and "natural" from the outside, but once one gets inside it, it opens out to burst the boundaries of that external naturalistic view' (Nagel 1997, p. 71-72).

In the spirit of Nagel's remark, I want to briefly address some of the main reasons for doubting that the naturalist epistemology outlined in the previous section can be usefully extended to naturalize social processes. I also want to suggest that this failure of extension, as I see it, is not necessarily cause for concern to naturalists. There is no doubt that the products of natural scientific research promote a sense of objective discovery that is lacking in the humanities and social sciences, where contestation is the norm. Yet naturalists need not worry that the lack of consensus in the social sciences is evidence of a lack of rigour, nor should they be surprised that epistemological consensus built on the testimony of experts has so far failed to induce meaningful social change in the political sphere, although this lack of progress is unquestionably a legitimate source of frustration. As the humanities and social sciences have long recognized, the 'space of reasons' for action, to use Wilfred Sellars' phrase, is not spanned by naturalist epistemic norms (Sellars, 1956). Human actions, and their justification, are governed by ethical, political, and other normative considerations that simply cannot be ignored when addressing the question of how to motivate social change. 'Trust us, we're experts' is not only unconvincing, it is repugnantly undemocratic.

A recent commentary in *Nature* (Lu et al., 2015) is further indicative of the sort of role that the natural science community envisions for social scientists. The authors suggest that social

[5] This attitude is reflected,for example, in Julian Simon's 'Can the Supply of Natural Resources be Infinite? Yes!' (Simon 1996).

scientists "should propose what sorts of data on behavior, values and beliefs should be collected and analyzed, how and by whom"(Lu et al., p. 433). Certainly the social sciences, like the natural sciences, are in the business of collecting empirical data. Quandaries nevertheless arise as soon as we begin to ask what sorts of data researchers of the Anthropocene ought to be collecting, how they should interpret the significance of the data, and of course how they propose to use the data once collected. Immediately we are temped to ask what licence social scientists, economists or otherwise, have to engage in such politically charged research. A naïve suggestion would be that social scientists are experts on social phenomena just as natural scientists are experts on natural phenomena. We are now in a position to diagnose the problems with this suggestion, from an epistemological point of view, which tell against this analogy regardless of the political and moral implications of construing social scientists as experts on social change processes.

It is possible to tease out some of the methodological similarities and differences between the natural and social sciences. As already alluded to, both the natural and social sciences engage in the systematic investigation of empirical phenomena. Daniel Little (2009) argues that social scientists routinely attribute genuine causal mechanisms to social phenomena. This need not mean that there are laws of social behaviour analogous to the laws of physics. The analogy with biology is more apt. Like physics, Darwin's theory has a great deal of epistemic warrant from a naturalist point of view. This is in part because of the great explanatory power of the principle of evolution via natural selection. Yet the generality of Darwin's theory as an account of natural variation in plants and animals is achieved in the absence of deterministic or even stochastic biological laws. The theory of evolution is also more akin to the social sciences than to Newtonian physics in the important respect that it is a theory of historical processes. The

evolution of life on earth is not a repeatable experiment, and we cannot predict the outcomes of natural selection systematically and quantitatively in the manner of Newton's laws, although it would be a mistake to conclude on this basis that Darwin's theory is not predictive.
Darwin's theory is unquestionably well confirmed in the sense demanded by naturalism, because of the extraordinary explanatory unification and fruitfulness that Darwin's synthesis achieved (Scriven 1959, Lieberson and Lynn, 2002). Even though biological laws are lacking, biological mechanisms are abundant, and testable generalizations from particular cases are readily extracted from the theory. For example, natural selection offers a ready explanation for the phenomenon of dwarfism among mammals living in isolated island ecologies. The explanation for this comes about through a general appeal to selection pressures, especially the competing pressures of energy conservation and predation, which work on all organisms.

Hence the lack of deterministic laws does not imply the absence of genuine causal mechanisms, some of which may be amenable to a naturalistic analysis. Furthermore, genuine social causal mechanisms obviously exist, and are systematically studied by social scientists (Tilly 2003, George and Bennett 2005). Despite these concessions, it would be a mistake to argue that social scientists study causal mechanisms in the same manner that natural scientists do. As Little (2009) points out, social mechanisms are driven by the actions and interventions of social agents. Treating agents as objects introduces unavoidable tradeoffs between generality and predictive power not found in physics or even in the life sciences. Agents are not homogenous by definition: they are original actors, the sui generis authors of their actions. By contrast, all electrons are essentially identical from the point of view of quantum mechanics, a fact which is partially responsible for the extraordinary predictive power of that theory. Grizzly bears are not

interchangeable, but it is possible and sometimes even fruitful to model population dynamics by abstracting away from the particular histories of particular large carnivores. This sort of strategy is generally unreliable in the social sciences, where the individuality of particular agents matters.

Any naturalized theory of social change appealing to the theoretical virtues outlined above would have to be mechanistic and predictive, in the sense that it would have to posit the existence of regular causal mechanisms open to public scrutiny. There are good reasons to doubt that the social sciences can be catalogued according to the values sketched above. Take the criterion of consistency for example. The actions of individual agents in different social domains need not be consistent with one another, nor are the theoretical accounts brought to bear to explain these actions burdened by such a criterion of consistency. It is entirely possible that two compelling social theories will make different and even incompatible predictions. This need not be problematic if the contexts (historical, cultural, etc.) of the two accounts are understood to be relevantly different. The natural sciences aspire to generalize away from the particulars of a case to examine universal trends. Good natural scientific theories are adept at finding the general in the particular. To borrow a phrase from Henri Poincare', 'it is not sufficient merely to observe; we must use our observations, and for that purpose we must generalize'. (Poincare, 1952, p. 140). The existence of human agency precludes the possibility of a general causal account of human change processes in this sense, despite the obvious causal interplay between social and natural phenomena. This suggests that buttressing the legitimacy of the social sciences by appeal to theoretical virtues found in the natural sciences is off the table. Nor can we hope to explain, let alone justify, social change processes by propping them up with a naturalist epistemology that places so much value on generalizability and the replicability and predictive power that

accompany it. While the ontology of natural and social systems are integrated, there are therefore good naturalistic grounds for thinking that natural and social processes should be kept analytically distinct from one another. To quote Hilary Putnam: 'As Kant saw, we are stuck with just the sort of dualism we never wanted- "dualities in our experience", as opposed to experience of duals, distinct substances.' (Putnum, 1982, p. 197). Putnum is referring to the duality of 'natural' and 'intentional' properties also alluded to in the quotation from Nagel above, a duality which helps to explain but also to justify the methodological gap between the natural and social sciences. Putnum warns against the temptation to be a 'scientific imperialist', while simultaneously defending a more moderate scientific realism which acknowledges the irreducibility of intentional (including some social) properties. This suggests that perhaps Putnum-style naturalists should not believe in an Anthropocene after all, if that concept attempts to undermine the essential dualism of natural and social (intentional) realms of experience on the grounds of a planetary state of emergency.

REEXAMINING THE ANTHROPOCENE NARRATIVE

The previous argument suggests that Baskin (2015) is correct: the Anthropocene is not a genuine scientific concept but an ideological one, connoting a particularly naive naturalistic or 'scientific imperialist' worldview However, it would be a mistake to accuse the natural science community of implicit technophilic motivations for invoking a 'state of emergency'. I have attempted to shed some light on the epistemological commitments of the naturalistic worldview, and I do not think that most naturalists are, or need be, technocratic in their political views. On the contrary, the main motivation of climate scientists and other experts concerned about climate change comes from their front-line view of anthropogenic biophysical transformation. According to some estimates, parts of the southern Asian continent will become uninhabitable by the year

2100 (Eun-Soon et al, 2016). This is cause for alarm, and a solution cannot come from doing more 'normal science' (Funtowicz and Ravetz, 1993). If we cannot change the status quo by simply asking the experts to do more science, what recourse do these scientists have in bringing public attention to the problem? Furthermore, what role can researchers in the social sciences and humanities play in climate change mitigation and adaptation?

We are best served to rely on the testimony of scientific experts when reaching conclusions about the natural world. The efficacy of the epistemic values brought to bear in the natural sciences is sufficient to warrant assent to the conclusions of the natural sciences, however uncomfortable they may be, when those values are applied in their legitimate domain. Anthropogenic climate change is no exception to this general maxim. Yet the social sciences and humanities have a very different role to play in social affairs. There is no such thing as an expert on social 'transformation', construed as a scientist endowed, through research and education, with a superior grasp of human nature and its third-person causal dynamics. Rather than assuming positions of power as managers, researchers in the social and humanistic domains play a crucial role in disseminating the findings of the natural sciences, helping to enable citizens to make informed choices for themselves, and promoting citizen autonomy and empowerment. It is no longer reasonable, if it ever was, to treat climate change as primarily a technical challenge. It is a massive political and moral problem.

Recognizing the political challenge posed by unsustainable human activity entails no longer treating 'humanity' as a monolithic entity, as the methods of the natural sciences have an unfortunate tendency to do (Brand, 2016). As many social scientists have emphasized, the narrative of the Anthropocene only serves to distract from the real social dangers of climate change, which may force actors in positions of power to navigate painful trade-offs between

competing values and priorities in the context of heterogeneous political arenas (Geden and Beck, 2014). Social scientists recognize and systematically investigate the heterogeneity of social phenomena. Such research therefore has a crucial role to play in navigating the pitfalls of incorporating natural scientific knowledge, itself a quasi-monolithic body of facts, theories, and the cognitive values that buttress them, into the variety of places, scales, cultures, and governance regimes that are the products of social processes. The task is not to identify beliefs antithetical to addressing the technical challenges identified by the sciences in order to change those beliefs, but to interpret the findings of the natural sciences in socially meaningful, authentic and context-sensitive ways. This is a task that demands the expertise of social scientists. Finally, it must also be recognized that addressing the challenges of sustainability is a humanistic project: human beings have a basic right to self-determination informed and empowered, rather than undermined, by the findings of the natural sciences.

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