An Ecocritical Theory of Scientific Abstractions

The Reification of Energy from Lukács to Habermas

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Abstract

This project proposes an ecocritical theory of scientific abstractions in order to investigate connections between scientific reason, societal organisation, and ecological decimation. The theory itself acts as a possible refinement of previous approaches, specifically the critique of the scientific outlook, as developed in Critical Theory from Lukács to Habermas. This largely theoretical endeavour is utilised in considering the concept of energy from thermodynamics and its larger cultural influences, as traced back to its origins in the scientific community of nineteenth-century Europe.

I argue that the concept of energy carries implicit obligations towards unification, intertranslation and industry, that have been utilised in the prioritisation of production over ecology, also that energy as an abstraction has been materialised (reified) into a cultural object that successfully masks the destructive impact of fuels. This argument is principally supported through an engagement with the various formulations of the reification critique from three approaches in Critical Theory; Lukács, Adorno and Horkheimer, and Habermas, all of which expose the effects of commodity exchange on rationality and, I argue, scientific abstractions.

Although largely a theoretical endeavour, the three approaches in Critical Theory are expanded into an analysis of the energy concept and its role in sustaining inaction towards the current ecological crisis. These include the public representation of oil companies and the persistence of neoclassical economic orthodoxy. Consequently, energy is investigated through its connection to theories of value, its representation in scientific and visual culture, its influence on the field of economics, and its position as a commodity.

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Introduction

The Voice of the Devil

All Bibles or sacred codes have been the causes
of the following Errors:

1. That Man has two real existing princi-
-ples, viz. a Body and a Soul.

2. That Energy, called Evil, is alone from the
Body, and that Reason, called Good, is alone from
the Soul.

3. That God will torment Man in Eternity
for following his Energies.

But the following Contraries to these are True.

1. Man has no Body distinct from his Soul
for that called Body is a portion of Soul discerned
by the five Senses, the chief inlets of Soul in this
age.

2. Energy is the only life and is from the Body
and Reason is the bound or outward circumference
of Energy.

3. Energy is Eternal Delight.

- William Blake, *The Marriage of Heaven and Hell* [1]

Energy *transforms*: In its contemporary usage—already pushed through the theoretical and cultural system of modern physics—energy connects and unifies all material phenomena through an underlying continuation. The disparate sensations of motion, heat, friction, and fatigue are all explained as merely different perceptive approaches to an underlying and ongoing energy process; continuation through the transformation of a single quantity.

Blake evokes energy prior to any notion of thermodynamics. Yet we observe in his prophetic treatise the very same duality. Energy is both evil and essential; foundational and fearful. In Blake's *Marriage*, the devil's voice mocks Emanuel Swedenborg's strict dichotomy of heaven and hell, good

[1] William Blake, *The Marriage of Heaven and Hell*, Copy E (London, 1794), p.4.

and evil, soul and body, in favour of a spiritualism that requires coexistence. 'Without Contraries is no progression. Attraction and Repulsion, Reason and Energy, Love and Hate, are necessary to Human existence'.[2]

Energy, at Blake's time, would partly signify the lineage of *energia* (ενέργεια) from Aristotle, meaning actuality as counter-distinct to potentiality, *dunamis* (δύναμις), the necessary conditions for and realisation of change and motion.[3] Energia would initiate the general conception of energy, the capacity to produce an effect, traceable back to the sixteenth-century. Yet Blake also clearly arouses energy as a quality of excitement and intensity, the carnal force of sensation, a meaning that was still developing in the eighteenth-century. [4]

Even Blake's theological usage, however, cannot compare to the transformation in meaning and importance energy would undergo throughout the nineteenth century. As with the emergence of a palpably 'modern science', with the discipline of physics at its helm, energy takes a central role in the conceptual reconfiguration of the world.

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The meaning of energy derived from thermodynamics may be used in defining our use of the term (scientific) *abstraction*. An abstraction here delineates a concept that exists via the taking away of information, or by tracing common elements amongst phenomena.[5] Abstractions can be thought of as the bracketing of qualitative information in order to isolate a causal explanation, usually one that can be measured. An abstraction therefore represents both the process of making a concept and a particular *kind* of concept; a quantity considered to be real (or relational) such as mass, gravity, or energy—notice these examples convey scientific explanations that cannot be viewed directly, but only through their *presence* in other objects such as planets, cars and molecules. I would also like to make a distinction between abstractions and abstract concepts (such as time, causality, or freedom), as

[2] Blake, p. 3.

[3] Potentiality and actuality are explicated in book Θ of Aristotle's Metaphysics; Aristotle, *The Complete Works of Aristotle*, ed. by J. Barnes (Princeton: Princeton University Press, 1984) v.II, pp.1651-1661. Also see Stephen Menn, 'The Origins of Aristotle's Concept of Ἐνέργεια: Ἐνέργεια and Δύναμις', *Ancient Philosophy*, 14, 1 (1994), 73-114.

[4] For an overview of the many different senses of energy in the *OED*; Clifford Sofield, 'Release Notes: The many faces of energy' (2018), <https://public.oed.com/blog/release-notes-the-many-faces-of-energy/> [accessed 20 September 2019].

[5] A notion originating in Locke. However, I do not wish to hold, as Locke does, that this is necessarily how the mind functions; only that abstractions are a particular form of concept. John Locke, *An Essay Concerning Human Understanding*, ed. by J. M. Dent (London: Everyman, 1993[1690]) p. 88.

abstractions here are considered to make up the foundation of the physical world while still remaining part of it. Alongside all concepts, however, abstractions will be treated as *social* entities—they are created and handed down, justified, dismissed and sometimes even deified in the process of making sense of the world.[6]

This dissertation intends to set out an ecocritical theory of scientific abstractions that can measure their cultural impact without rejecting their legitimacy. In evidencing this theory, a question this dissertation seeks to answer is How, if at all, has the concept of energy from thermodynamics been complicit in the social practices that sustain the crisis of global warming? The method of investigation appeals to the concept of 'reification' from Critical Theory to provide a catalyst between the cultural impact of scientific abstractions and the societal organisation that reproduces ecological devastation. The project, therefore, is inevitably one of explication and the 'mapping' of abstractions, rather than exposing tangible ecological problems.

The conservation of energy from nineteenth-century thermodynamics will be invoked as an archetypal instance of scientific abstraction, one that is has been reified to become what I term *energy as energy*; and mobilised in justifying the political and industrial dogma of a society dependent on fossil fuel consumption. These views of energy, it will be argued, obfuscate the necessary political and social reorganisation required from the crisis of global warming and ecological decimation.

The readings of Critical Theory from Lukács to Habermas are intended to excavate an anxiety around the cultural impact of scientific abstractions, namely their hold over political and sociological discourse. Isabelle Stengers, in analysing the philosophy of A.N. Whitehead, notes a similar concern with 'the lack of resistance characteristic of the modern epoch to the intolerant rule of abstractions that declare everything that escapes them frivolous, insignificant, or sentimental'.[7] Yet the Frankfurt School in particular provide a connective mechanism between political economy, psychological experience and interpersonal communication that may prove vital when appraising the influence of scientific abstraction in everyday life. Here, energy provides a conceptual bridge to rehabilitate Critical Theory under current economic and ecological imperatives.

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[6] Isabelle Stengers *Thinking with Whitehead: A Free and Wild Creation of Concepts*, trans. by M. Chase (Cambridge: Harvard University Press, 2011), pp. 123-42. Also see; Gilles Deleuze and Felix Guattari, *What is Philosophy?*, trans. by H. Tomlinson and G. Burchell (New York: Columbia University Press, 1994), pp. 15-34.

[7] Isabelle Stengers, *Thinking with Whitehead*, p. 136; in reference to Whitehead's *Science and the Modern World*; Alfred N. Whitehead, *Science and the Modern World* (Cambridge: Cambridge University Press, 1926).

The connection between psychology, sociology and political economy that makes up the reification critique are threefold: [8]

1) The experience of our surroundings is rendered into 'objects' by over-applying the quantification and valuation necessary for commodity exchange.

2) In approaching our interaction with others from this reifying stance, we thereby take an instrumental approach to inter-human communication.

3) Abstracting from ourselves the useful and 'commodifiable' facets of our psychology (e.g. 'intelligence', 'creativity', 'entrepreneurship', etc.) and emphasising these qualities to the point where they become external to us.

As reification is going to constitute the catalyst between energy as a scientific abstraction and the crisis of global warming, the structure of this study follows three formulations of reification throughout a strand of 'Western Marxism', from Lukács, to Horkheimer and Adorno, to Habermas.[9] It is proposed that these three forms of reification (that loosely map onto a concern with value, epistemology, and societal organisation respectively) provide different mechanisms for scientific concepts to extend beyond their realm of application. A new all-encompassing theory of reification will not be attempted, nor will one formulation be defended against the others. Rather, I am interested in the many ways in which scientific abstractions can become politicised through the logic of commodity transaction.

Section 1 looks at the emergence of energy within the science of thermodynamics through nineteenth-century Europe, as well as the emergence of reification as a sociological critique in the work of György Lukács. By investigating the historical and cultural facets of thermodynamics, I intend to show how abstractions are formed under a conglomeration of social presuppositions and political motives; most conspicuously the desire for unification.

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[8] Axel Honneth, *Reification: A New Look at an Old Idea*, ed. by M. Jay (Oxford: Oxford University Press, 2008), p.22. For an influential parallel to this idea, see Arlie Hochschild, *The Managed Heart: Commercialization of Human Feeling* (Berkeley: University of California Press, 1983).

[9] The term 'Western Marxism' was introduced by Merleau-Ponty to characterise the tradition of theorists who followed Lukács in rejecting the more 'scientific' form of Marxism spearheaded by Engels and Lenin. It is typically a short hand for twentieth-century Marxists critical of the Soviet system: Maurice Merleau-Ponty, *Adventures of the Dialectic*, trans. by J. Bien (Evanston: Northwestern University Press, 1973 [1955]). The phrase Critical Theory used here will denote the three approaches of Western Marxism covered, unless stated otherwise.

The discussion of Lukács elucidates reification in its original formulation and its central reference to the Marxist commodity structure; as well as looking at its concern with science and abstractive thought. This will help to sketch out an ecocritical theory of abstractions, which will be contrasted with other key ecocritical approaches in order to map out some of its primary assumptions (in particular, a refutation of deep ecology and holism).

Crucial to reification is a conception of value, which constitutes a connective theme in the current investigation. This is not only because value connects a dimension of psychology and experience to matters of political economy through what is subjectively perceived as valuable, but also because what our present society *values* speaks directly to issues around conservation, preservation and ecology. This is evidenced by those who explore Marx's contribution to Green movements via his 'labour theory' of value.[10]

The critique of reification takes an epistemological turn in Section 2. This is achieved through a reading of Adorno and Horkheimer's *Dialectic of Enlightenment* that explicates the method through which they link abstractive thinking to concerns around ecological decimation. Their critique of positivism is explored, and it is argued that both a positivist and a contradictory 'vulgar realist' version of the energy concept result in different forms of reification. That is, abstractions such as the energy concept may become *reifacts* when denied their emergence in historical, cultural and political contexts, whereby they become employed as 'norm-free' political tools.[11]

Section 3 moves on to the functionalist formulation of reification proposed by Jürgen Habermas, specifically in its manifestation as the 'colonisation of the lifeworld' put forward in *The Theory of Communicative Action*. This is in order to assess the influence that major scientific abstractions such as energy may have on our ability to communicate (lifeworld) and in the organisation of society (system). The debate around the ecological applicability of Habermas's theory indicates a concern that an overreliance on communication inhibits its ability to account for the global warming crisis.

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[10] Matthew Huber, 'Value, Nature and Labor: A defence of Marx', *Capitalism, Nature, Socialism*, 28, 1 (2017), 39-52; Paul Burkett, 'Nature in Marx Reconsidered', *Organisation and Environment*, 10, 2 (1997), 164-83. Also, for a classic text, see Alfred Schmidt, *The Concept of Nature in Marx*, trans. by B. Fowkes (London: New Left Books, 1971 [1962]) pp. 63-75.

[11] 'Reifact' taken from Sónia Silva, 'Reification and Fetishism: Processes of transformation', *Theory, Culture & Society*, 30, 1 (2013), 79-98: 'Fetishes do not share their ontological status, physical appearance, or functional attributes; they share their being reifacts. To speak of fetishism is to speak of reification, the universal human tendency to apprehend abstractions as things', p. 80.

I argue that the concept of energy is reified into a commodity that masks the inherent instability of fossil fuel consumption. The influence of energy on social organisation is further explored by the appropriation of thermodynamics in justifying neoclassical economic structures that still dominate the field, a position ultimately incapable of accounting for the imminent catastrophes of global warming.

A theme throughout consists in diagnosing the misapplication of scientific abstractions to ethical or political realms, a concern shared with certain *constructivist* readings of science.[12] The production of scientific facts within a given disciplinary or experimental context—whether this makes them *real* or not—in some way designates their scope of applicability. In much the same way that vulgar readings of evolution have often led to (or perhaps only justified) a patriarchal defence of gender normativity, I will argue that thermodynamics has been mobilised in the formation of political structuring frequently referred to as neoliberalism.

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An interdisciplinary approach emerging under the name of 'energy humanities' attempts to show the ways in which 'the energy riches of the past two centuries have influenced our relationships to our bodies, moulded human social relations, and impacted the imperatives of even those varied activities we group together under the term "culture" '.[13] This approach implies, therefore, that our epistemic connection to fossil fuels goes beyond simply knowing the problematic implications of their use, instead becoming an active participant in knowledge formation in contemporary society on both individual and intersubjective levels. In other words, the creation of what has been termed a 'petroculture' has brought with it a potential distortion of perceptual experience, one that figures pre-consciously and pervasively. The similarities between this approach and my own manifest in drawing out the transformative capability within the materiality of fuels (as well as fuels anthropomorphic qualities imbued upon them) and how this may alter our stance towards the world around us.[14] However, I wish to push the scope of investigation into the scientific conception of energy itself, as well as the direct impact thermodynamics has had on/from wider cultural realms.[15] Therefore,

[12] Particularly exemplified in Stengers's *Cosmopolitics*: Isabelle Stengers, *Cosmopolitics I*, trans. by R. Bonobo (Minneapolis: University of Minnesota Press, 2010); *Cosmopolitics II*, trans. by R. Bonobo (Minneapolis: University of Minnesota Press, 2011).

[13] Imre Szeman, and Dominic Boyer, eds., *Energy Humanities: An Anthology* (Baltimore: John Hopkins University, 2017), p. 2.

[14] For example, Frederick Buell, 'A Short History of Oil Cultures: Or, the marriage of catastrophe and exuberance' *Journal of American Studies*, 46, 2 (2012), 273-293.

[15] Important texts on the culture of thermodynamics have been: Serres's chapter 'Turner Translates Carnot' which explicates the realisation of thermodynamics in nineteenth century artwork; Michel Serres, *Hermes: Literature, Science, Philosophy*, trans. J. V. Harari and D. F. Bell (Baltimore: John Hopkins University Press,

included is an example of how the cultural views derived from thermodynamics, its scientific and visual representation, have been utilised by oil companies and industrial complexes in the process of this distortion.

The Critical Theory of the Frankfurt School tradition has often been invoked in formulating an environmental sociology and ecological theory. This has often functioned through an exploration of the concept of 'nature' in Critical Theory, such as those by Kate Soper and Steven Vogel.[16] Ryan Gunderson has collated the various ways that the 'first generation' (Adorno, Horkheimer, Marcuse) have been influential in environmental sociology surrounding the treatment of animals and technology respectively;[17] as well as the controversy surrounding Habermas's break from the previous Critical Theorists.[18] Sabine Wilke represents a recent attempt to harmonise the philosophy of (primarily) Adorno with the demands of the Anthropocene.[19] Here, however, I propose that the Frankfurt School can be used to analyse the impact of scientific abstractions, with the ecological crisis forming the

1982), pp. 54-64. Clarke expands on this work in the use of energy as allegory; Bruce Clarke, *Energy Forms: Allegory and Science in the Era of Classical Thermodynamics* (Ann Arbor: University of Michigan Press, 2001). Rabinbach presents a thorough analysis of the influence of thermodynamics on psychology and body-image; Anson Rabinbach, *The Human Motor: Energy, Fatigue, and the Origins of Modernity* (Berkeley: University of California, 1990). Smith has given a cultural history of nascent energy physics in Victorian Britain and its connection to industrial and marine engineering; Crosbie Smith, *The Science of Energy: A Cultural History of Energy Physics in Victorian Britain* (Chicago: University of Chicago Press, 1998); 'Engineering Energy: Constructing a new physics for Victorian Britain', in *The Oxford Handbook of the History of Physics*, ed. by J. Z. Buchwald and R. Fox (Oxford: Oxford University Press, 2013). Harman gives a concise overview of the conceptual turn in physics and the role of energy in the establishment of physics; Peter Harman, *Energy Force and Matter: The Conceptual Development of Nineteenth-Century Physics* (Cambridge: Cambridge University Press, 1982).

[16] Kate Soper, *What is Nature?: Culture, Politics and the Non-Human* (Oxford: Blackwell, 1995). Steven Vogel, *Against Nature: The Concept of Nature in Critical Theory* (Albany: SUNY Press, 1996); *Thinking like a Mall: Environmental Philosophy after the End of Nature* (Cambridge: MIT Press, 2016).

[17] Ryan Gunderson, 'The First-generation Frankfurt School on the Animal Question: Foundations for a normative sociological animal studies', *Sociological Perspectives*, 57, 3 (2014a), 285-300; 'Environmental Sociology and the Frankfurt School 1: Reason and capital', *Environmental Sociology*, 1, 3 (2015), 224-35; 'Environmental Sociology and the Frankfurt School 2: Ideology, techno-science, reconciliation', *Environmental Sociology*, 2, 1 (2016), 64-76. Also see the essays collated in Andrew Biro, ed., *Critical Ecologies: The Frankfurt School and Contemporary Environmental Crises* (Toronto: University of Toronto Press, 2011).

[18] Ryan Gunderson, 'Habermas in Environmental Thought: Anthropocentric Kantian or forefather of ecological democracy?', *Sociological Inquiry*, 84, 4 (2014b), 626-53.

[19] Sabine Wilke, 'Enlightenment, Dialectic, and the Anthropocene: Bruised nature and the residues of freedom', *Telos*, 177 (2016), 83-106; 'Critical Theory and Ecology: The shape of performance in the Anthropocene', *Telos*, 183 (2018) 25-46. Also see Harriet Johnson, 'The Reification of Nature: Reading Adorno in a warming world', *Constellations*, 26 (2019), 318–329.

looming backdrop and reconnecting us with contemporary research in the fields of green policy, science and technology studies, and ecocriticism more generally.

Moreover, this study has set its sight on one particular facet of Critical Theory within the Frankfurt School tradition, reification, which has its own (head-scratching) past.[20] Whitehead, in reference to Zeno, stated that 'to be refuted in every century after you have written is the acme of triumph', and it is starting to seem that reification in its many forms is making for a sociological equivalent.[21] Indeed, the current investigation benefits from the recent resurgent interest in reification following Axel Honneth's monograph.[22] However, a detailed discussion of Honneth's theory in an ecological context is left to another investigation.

[20] See Pitkin for an account of all the various understandings of this single concept; Hannah Pitkin, 'Rethinking Reification', *Theory and Society*, 16, 2 (1987), 263–93.

[21] Alfred N. Whitehead, *Essays in Science and Philosophy* (New York: Philosophical Library, 1947), p. 114.
[22] See Honneth, Butler, Lear, Geuss and Jay collected in Honneth, *Reification*. Further responses by Timo Jütten, 'What is Reification? A critique of Axel Honneth', *Inquiry*, 53, 3, (2010), 235-56; Alastair Morgan, 'The "Living Entity": Reification and forgetting', *European Journal of Social Theory*, 17, 4 (2014), 377-388; David Schafer, 'Pathologies of Freedom: Axel Honneth's unofficial theory of reification' *Constellations*, 25 (2018), 421– 31; and Matthew Smetona, 'Reification: A defence of Lukács's original formulation', *Angelaki*, 23, 5 (2018), 32-47. Also see Anita Chari, 'Toward a Political Critique of Reification: Lukács, Honneth and the aims of Critical Theory', *Philosophy & Social Criticism*, 36, 5 (2010), 587-606; Todd Hedrick, *Reconciliation and Reification: Freedom's Semblance and Actuality from Hegel to Contemporary Critical Theory* (Oxford: Oxford University Press, 2018); and Dimitris Gakis, 'Reification and Immaterial Production', *Philosophy & Social Criticism* (2019).

Section 1: 'Class Consciousness' and Thermodynamics

> They held the commodity in healthy disdain; and the commodity itself, finding no comfortable home among them, naturally fled.
>
> -Saro-Wiwa, 'The Inspector Calls'.[23]

This first section intends to set out in greater detail the concepts being employed in formulating an ecocritical theory of abstractions. Firstly, I intend to clarify the position of the energy concept from thermodynamics as an archetypal scientific abstraction, and to prove that such abstractions form under the pressure of political and cultural demands prevalent in their historical context of emergence. It is important to keep in mind, however, that in outlining the historical influence on abstractions I intend to make no claim to an implicit falsity—even where this history may be considered morally reprehensible. Evidently, the concept of energy from thermodynamics has easily exceeded the bounds of its crucible in nineteenth century Europe; and remains a foundation for the theoretical endeavours of contemporary physics and environmental policy alike. Rather, the purpose of investigating the historicity of abstractions in this way is to discover what these scientific theories *may* implicitly compel us to ascribe to when we accept them as true descriptions of the world around us.

Once thermodynamic energy has been outlined as a scientific abstraction, the concept of reification will be defined through its initial treatment in the work of Lukács, specifically in the text *History and Class Consciousness*. Particular emphasis will be given to its concern with science and scientific theory, as well as its concern more generally with the connection between ideas (or *consciousness*) and capitalist production beyond the crude base-superstructure formulation commonly ascribed to an idea of Marxist theory.[24] The ecocritical reading of Lukács will then be clarified by contrasting it with a selection from the field of ecocriticism, which will go some way to delineate what a critique of abstractions entails.

Finally, the significance of energy and reification in setting out an ecocritical theory of abstractions will be buttressed by investigating the connections between the two concepts—as reification is interpreted as a response, in part, to the obligations for a unified cosmological outlook and value implicit in the energy concept.

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[23] Ken Saro-Wiwa, *A Forest of Flowers* (Essex: Longman, 1995), p. 16.

[24] For a critique of the base-superstructure interpretation of Marx, see Raymond Williams, 'Base and Superstructure in Marxist Cultural Theory', *New Left Review*, 0, 82 (1973), 4-17.

1.1 Energy and the Vase of Circe: The emergence of a concept

Around 1850, the western European scientific community witnessed what would be later deemed a 'simultaneous discovery'.[25] In the universities and scientific academies primarily of France, Germany, England, and Scotland, physicists were publishing ground-breaking work on the conversion and conservation of heat and motion. Energy became the name to symbolise the quantification of this translation, and one of its defining features would be its ability to intertranslate disparate properties, fields, and disciplines.[26]

Although Kuhn located the roots of this simultaneous discovery in a shared philosophy of nature, I argue that in many ways the willingness to embrace the energy concept had underlying social causes, specifically a shared desire for the unification of the sciences:[27]

The unity of science had been called for by the cultural stipulations of the Enlightenment and the colonial sentiments of a European superiority that went with it. Throughout the eighteenth century, Enlightenment thought had become almost synonymous with supporting scientific intervention in pedagogy, politics, and even religion—establishing science as possessing an almost unrivalled cultural potency by the nineteenth century. Advancements in science were not only crucial in expanding empires, but a unified science meant that a cohesive ideology could be spread throughout colonies: 'The common bond of analysis is daily expanding its empire, and will ultimately embrace almost every subject in its formulae'.[28] (See fig.1).

[25] See Thomas Kuhn, 'Energy Conservation as an Example of Simultaneous Discovery', in *Critical Problems in the History of Science*, ed. by M. Clagett (Madison: University of Wisconsin Press, 1959) pp. 321-56.

[26] Ilya Prigogine and Isabelle Stengers, *Order Out of Chaos: Man's New Dialogue with Nature* (London: Verso, 1984), p.106.

[27] This and the following analysis are informed by Stephen Gaukroger, *Civilization and The Culture of Science: Science and the Shaping of Modernity, 1795-1935* (in press), ch.3 and 4—obtained via private correspondence. Also see Yehuda Elkana, *The Discovery of the Conservation of Energy* (Cambridge, Harvard University Press, 1974), for an influential overview of energy and its social presuppositions.

[28] Mary Sommerville. *On the Connexion of the Physical Sciences,* (London: John Murray, 1831), p. 413.

Figure 1: G. F. Watts, the infamous Victorian artist, pictured in front of a cast of his last sculpture, 'Physical Energy', 'a symbol of that restless physical impulse to seek the unachieved in the domain of material things'.[29] *Of the four full-size bronze casts made, one remains in Kensington Gardens, London; another stands guard to the Cecil Rhodes Memorial, Cape Town; a third, commissioned by the contemptible British South Africa Company for the steps of the Lusaka High Court in colonial Rhodesia, can now be found in the grounds of the National Archives in Harare, Zimbabwe.*

[29] Description by the sculptor in George Watts, *George Frederic Watts, Vol.3: His Writings*, ed. by M. Watts (London: Macmillan, 1912), p. 270. Image; G. F. Watts with the plaster model of 'Physical Energy', outside his sculpture studio in Kensington, 1890s; retrieved from <https://www.royalacademy.org.uk/exhibition/physical-energy> [accessed 25 September 2019].

In many cases, a unification of science became wrapped up with nationalist sentiments. For example, du Bois-Reymond viewed scientific unification achieved by the energy concept not only to be a symbol of the political unification of Germany, but in fact beheld the newly possible connections between the German universities as being causal in the political process. Whereas in Britain the dissemination of affordable science literature that required a more approachable overview of *science* as a single coherent subject (e.g. through Henry Brougham's Society for the Diffusion of Useful Knowledge) had strong connections to 'progressive' Whig ideology and politics.[30]

In fulfilling the role of grand unifier within national and colonial realms, thermodynamics reflected a goal it implicitly shared with Enlightenment philosophy. As Prigogine and Stengers note, the 'tendency to see natural phenomena as the products of an underlying reality that remains constant throughout its transformations' has an eerie closeness to the Kantian conception of the noumena—and Herman von Helmholtz was especially cognisant of the Kantian inflection behind energy, viewing it as the *a priori* foundation for the possibility of all science:[31]

> The theoretical science of nature shall have fulfilled its mission when the reduction of phenomena to elementary forces is accomplished and when this reduction is known to be the only possible one. *Then the reduction would be proved to be the necessary comprehending form of our conception of nature, and it would be regarded as objectively true*.[32]

However, the philosophical explicitness of Helmholtz was in no means shared by his fellow nascent physicists who, as we shall observe, saw thermodynamics as necessarily in opposition to metaphysics.

Of course, mathematical reduction had been proposed as a foundation to a united science since at least Galileo and Kepler. However, it was not until the refinement of rational mechanics (Descartes, Newton, Huygens, etc.) by mathematicians such as Leonhard Euler and Lagrange that mechanical reductions began to gain the predictive power necessary for their larger acceptance. Yet the physical equivalence of this already accepted mathematical unification was decidedly lacking, and new

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[30] James Secord, *Visions of Science: Books and Readers at the Dawn of the Victorian Age* (Oxford: Oxford University Press, 2014), pp. 109-112.

[31] Prigonine and Stengers, p. 110.

[32] Helmholtz, quoted in Olivier Darrigol, *Physics and necessity: rationalist pursuits from the Cartesian past to the quantum present* (Oxford: Oxford University Press, 2014), p. 77, my emphasis.

theories of heat transference tended to completely replace older ones (such as Fresnel's luminiferous ether) rather than refining them towards some generally recognised theory.[33]

In 1834, Mary Somerville's *On the Connexion of the Physical Sciences* would grip the imagination of Regency Britain with claims to a mathematical link between sciences, suggesting 'that they will ultimately be referred to the same agent: and in all there exists such a bond of union, that proficiency cannot be attained in any one without a knowledge of the others'.[34] Somerville's popular book collated many of the disparate fields in natural philosophy at the time, providing an imaginative and accessible insight into the establishment of a new science; one that could attest to its own validity through the 'intertranslatability' of its concepts. [35]

Another key text relevant to us in the unfolding of the energy concept is Peter Guthrie Tait and William Thompson's *Treatise on Natural Philosophy* (1867), in which the discordant authors offered a thoroughly reformed natural philosophy, with Joule's experimentally proofed conservation of energy at its foundation, yet masked in presentation as a re-reading of Newton's near-sacred *Principia*.[36] Again, a nationalist disposition was perhaps influential in strengthening a long line of Scottish empiricism, in so doing establishing a physics devoid of the metaphysics purported by followers of Leibniz on the continent. This anti-metaphysical stance went so far as to employ a purely measurable/pragmatic definition of matter as something perceptible through the senses, to the private dismay of more philosophically informed scientists such as James Clerk Maxwell.[37] Publicly, however, Maxwell would unequivocally praise the *Treatise* in his *Nature* review, perhaps indicating a significance to the physicist community too important for philosophical nit-picking.

More local matters also played a role for Thomson and Tait as, with the conservation of energy being contextualised within the working machine and direct gratitude towards local hero James Watt, the wealth-producing industrial power of 1860s Glasgow was implicitly called upon as supporting

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[33] Gaukroger, ch.3.

[34] Somerville , p. v; Secord, pp. 107-137.

[35] 'Intertranslatability' taken from Gaukroger.

[36] Smith, *The Science of Energy*, pp. 192-210.

[37] Smith, *The Science of Energy*, p. 200. Maxwell, misquoting Berkeley, in turn quoting Evangelista Torricelli, argues that matter can never be perceived: 'Matter is nothing but an enchanted vase of Circe fitted to receive Impulse and Energy, essences so subtle that nothing but the inmost nature of material bodies is able to contain them'; James Clerk Maxwell, *The Scientific Letters and Papers of James Clerk Maxwell, Vol. II*. Ed. by P. M. Harman (Cambridge: Cambridge University Press), p. 395. Berkeley does not use 'Energy and Impulse', but rather 'force and the momenta of impulse'; George Berkeley, *The Works of George Berkeley, Vol II.* Trans. and ed. by G. N. Wright (London: Thomas Tegg, 1843), p. 86.

evidence. A typical entwinement of empiricism and industry—the foundation of a renovated physics was one that could bring wealth to the empire, launching productivity as the new metaphysics.

As implied, energy in the nineteenth century did not remain simply one scientific theory among many, it enveloped the discipline to become synonymous with scientific investigation itself; the science of energetics. In a paper delivered to the Glasgow Philosophical Society in 1855 titled 'Outlines of the Science of Energetics', W. J. M Rankine set out the basic tenets of this new method. The first axiom of which returns us to our opening statements:

> The efforts and passive accidents to which the branches of physics relate are various and heterogeneous; but they are all connected with *energy*, a uniform species of quantity, which pervades every branch of physics.
>
> This axiom is also equivalent to saying, that *energy is transformable and transferable*….[38]

Yet in reaching this conclusion Rankine shows his cards quite clearly; priority is given to *physical* over *abstract* theories, and in turn to *abstractive* over *hypothetical* methods of forming these physical theories; of which mechanics and energy form pinnacle cases. Abstractive methods are delineated as the commonalities between observable phenomena such as the motion 'common to the fall of heavy bodies, the flow of streams, the tides, the winds, the vibrations of sonorous bodies, the revolutions of the stars'. [39] These abstractive approaches characteristic of mechanics deserve widespread application due to their predictive power and utility—the encroachment towards a 'perfect engine'. Whereas hypothetical theories have the potential to become 'evil' when used to 'explain away, or set aside, facts inconsistent with these hypotheses'.[40]

Our use of abstraction is not the same as Rankine's. Abstract theories in Rankine's system represent those of a metaphysical quality, as their presence is assumed rather than observed in physical interactions. Abstractive methods, however, are praised as those that filter out the unnecessary qualities of physical objects in formulating a theory. To Rankine, energy represents an ideal example of a physical-abstractive theory—as the abstracted connections common to motion, heat, and chemical reactions. We, however, have noted that even with the purported abstractive method of the

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[38] William J. M. Rankine, 'Outlines of the science of energetics', *Edinburgh philosophical journal*, 30 (Edinburgh: Neill and Company, 1855), p. 14.

[39] Rankine, p. 5.

[40] Rankine, p.7.

energy concept comes a number of obligations and outlooks typical to the cultural stipulations of nineteenth century Europe, and thereby imbibed with a fundamental proclivity towards productivity, unification, and intertranslatability. The consequences of such obligations will be explored through our current reading of Critical Theory, starting with the work of Lukács.

1.2 The Emergence of a Concept II: Value, reified

> Caleb Garth often shook his head in meditation on the value, the indispensable might of that myriad-headed, myriad-handed labour by which the social body is fed, clothed, and housed. It had laid hold of his imagination in boyhood. The echoes of the great hammer where roof or keel were a-making, the signal-shouts of the workmen, the roar of the furnace, the thunder and plash of the engine, were a sublime music to him; the felling and lading of timber, and the huge trunk vibrating star-like in the distance along the highway, the crane at work on the wharf, the piled-up produce in warehouses, the precision and variety of muscular effort wherever exact work had to be turned out, - all these sights of his youth acted on him as poetry without the aid of the poets, had made a philosophy for him without the aid of philosophers, a religion without the aid of theology.
>
> - George Eliot, *Middlemarch*.[41]

György Lukács's 1923 text *History and Class Consciousness* shares its approach with that of an early sociology exemplified by Weber and Simmel, one which conceptualised the practices of a modern society in distinction to those of a traditional society.[42] Underpinning Lukács's appropriation of Weberian rationalisation, however, is a philosophical investigation of Marx's commodity-structure and commodity-*fetishism*; as well as an explanation to the inaction of the proletariat of his native Hungary, to their lack of a 'class consciousness'.

In the opening section of *Capital I*, Marx demonstrates the underlying value of commodities *qua* the value of human labour: 'As exchange-values, all commodities are merely definite quantities of *congealed labour-time*'.[43] It is precisely this root labour-value that allows commodities to be exchanged. That is, when qualitatively different objects are equated in a trade situation (e.g. one coat for twenty yards of linen), it is the abstracted human labour socially necessary in the production of both that allows them to be compared, thus losing most of the qualitative information in the process. This process, prescribed as a labour theory of value co-opted from the classical economist Ricardo,

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[41] George Elliot, *Middlemarch* (London: Penguin, 1965 [1872]), p. 283.

[42] György Lukács, *History and Class Consciousness*, trans. by R. Livingstone (Cambridge: MIT Press, 1971 [1923]); abbreviated to *HCC*.

[43] Karl Marx, *Capital, Vol. 1*, trans. by B. Fowkes (London: Penguin Books, 1976), p. 130, emphasis in original.

represents Marx's attempt to solve the interminable problem of commensurability in theorising trade, how qualitatively different objects can be meaningfully exchanged, and their value measured. [44]

Consequently, *Capital* presents a commodity only simple at face value, in fact 'abounding in metaphysical subtleties and theological niceties' (Marx, p. 163). For whenever raw materials are furnished into commodities they are imbued with a particular sense of legitimacy in their transition.[45] In the process of this transformation 'the commodity reflects the social characteristics of the products of labour themselves, as the socio-natural properties of these things' (Marx, pp. 164-65). That is, the commodity appears objective and immutable, losing signs of its social origin in labour.

Lukács, in his essay 'Reification and the Consciousness of the Proletariat', takes this phenomenon of objective appearance and expands it in order to answer the question 'How far is commodity exchange together with its structural consequences able to influence the total outer and inner life of society?' (*HCC*, p. 84).

The answer to which is significantly so, for the commodity-structure permeates throughout societal life by attaching itself to processes of modernisation that structure the psychological formation of value, such as work institutions and money, as evidenced by Weber and Simmel respectively. The institutionalisation of the commodity-structure allows for labour, bureaucratic/managerial, and even creative work to be reified into objects devoid of sociality—even one's own abilities begin to appear as external commodities. Money and economic structures aid in the spread of reification through the quantification of value, invading all facets of our public and private lives.

The mechanism of reification is thus summarised:

> The transformation of the commodity relation into a thing of 'ghostly objectivity' cannot therefore content itself with the reduction of all objects for the gratification of human needs to commodities. It stamps its imprint upon the whole consciousness of

[44] The typical view, however, that Marx simply took the labour theory of value from Ricardo, is challenged by David Harvey, 'Marx's Refusal of the Labour Theory of Value' (2018), <http://davidharvey.org/2018/03/marxs-refusal-of-the-labour-theory-of-value-by-david-harvey/> [accessed 20 September 2019].

[45] In an excellent passage, Marx relates the commodity of a table:

> The form of wood, for instance, is altered if a table is made out of it. Nevertheless the table continues to be wood, an ordinary sensuous thing. But as soon as it emerges as a commodity, it changes into a thing which transcends sensuousness. It not only stands with its feet on the ground, but, in relation to all other commodities, it stands on its head, and evolves out of its wooden brain grotesque ideas, far more wonderful than if it were to begin dancing of its own free will (Marx, pp. 163-64).

> man; his qualities and abilities are no longer an organic part of his personality, they are things which he can 'own' or 'dispose of' like the various objects of the external world. And there is no natural form in which human relations can be cast, no way in which man can bring his physical and psychic 'qualities' into play without their being subjected increasingly to this reifying process (*HCC*, p. 100).

In order to appreciate the philosophical character of this process, it is helpful to consider the German phrase *Gegenständlichkeitsform* ['form of objectivity'] used by Lukács in describing perception within a 'bourgeois-society' controlled by the logic of commodity exchange.[46] The term denotes a (neo-Kantian) conception that the perception of our objective reality is structured by subjective 'forms'. Rather than maintaining a tenet of German Idealism that these subjective forms or paradigms are determined by the individual mind, Lukács views these forms as socially and historically determined (in line with Hegel and Marx). Therefore, under the capitalist form of social organisation, experience arrives to us in the commodity form, as *things* to be traded, sold, or acquired. Yet this experience of the world is an impoverished one, incomplete and rife with contradiction.

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The role of science and nature in *HCC* take a somewhat distinctive role as entities that lie outside the domain of social (and therefore dialectical) investigation. This marks a notable break from Engels, who formulated the application of Marx's dialectical method to science and the natural world in works such as *Anti-Dühring* and the essays later collected in *Dialectics of Nature*.[47] Lukács explains that the 'crucial determinants of dialectics—the interaction of subject and object, the unity of theory and practice, the historical changes in the reality underlying the categories as the root cause of changes in thought etc.—are absent from our knowledge of nature' (*HCC*, p. 24, fn6). Dialectical investigation is consequently designated to strictly social and historical realms.[48] Which, in turn, is

[46]*HCC*, p. 83; See Andrew Feenberg, 'Why Students of the Frankfurt School will have to read Lukács', in *The Palgrave Handbook of Critical Theory* (New York: Palgrave Macmillan, 2017), p.113.

[47] Friedrich Engels, *Herr Eugen Dühring's Revolution in Science (Anti-Dühring)* (London: Lawrence and Wishart Limited, 1934 [1878]); *Dialectics of Nature* (Moscow: Progress Publishers, 1976).

[48] Lukács follows Dilthey in the separation between the *Geisteswissenschaften* and the *Naturwissenschaften* in the original German edition (e.g. see *HCC*, p. 346). Although Lukács does not explicitly credit Dilthey despite mentioning him in both the text and revised preface in 1967, the separation in terms is reinforced by the separation in methodology; see Paul Burkett, 'Lukács on Science: A new act in the tragedy', *Historical Materialism*, 21, 3 (2013), 3-15.

largely considered a key conceptual structure for the theorists associated with the Frankfurt Institute for Social Research.

However, to imply that the 'knowledge of nature' constituted as modern science holds a unique epistemological position compared to other modes of investigation creates a lasting contradiction. Rather, it may be more appropriate (and is largely implied throughout *HCC*) that the conception and study of nature should be designated to the social realm which in turn allows the knowledge of, and interaction with, nature to become reified.[49] Accordingly, in a defence of *HCC* written a few years later—though unpublishable in the political climate and only resurfacing at the end of the century—Lukács indeed forwards the position that, 'Our consciousness of nature, in other words our knowledge of nature, is determined by our social being'.[50]

Nonetheless, there remains a critique of science in *HCC* for its lack of social self-consciousness; asserting that the 'more intricate a modern science becomes and the better it understands itself methodologically, the more resolutely it will turn its back on the ontological problems of its own sphere of influence and eliminate them from the realm where it has achieved some insight' (Lukács, *HCC*, p. 104). Clearly, this represents a concern with the dogmatic assurance of method in the sciences, one that we will see shared by later Critical Theorists.

Yet Lukács does not entirely abandon the objective focus of science, conveyed as the (imperceptible) material foundation upon which all sensation is grounded. Rather, without historical self-reflection science will find that 'the world lying beyond its confines, and in particular the material base which it is its task to understand, its *own concrete underlying reality* lies, methodologically and in principle, *beyond its grasp*' (*HCC*, p. 104, emphasis in original.).

This complicates the notion that nature and *Naturwissenschaften* can be reduced to social behaviour without leaving a residue, and instead opts for a scientific view that incorporates historical and social requirements to look beyond what is immediately given in sense perception. In other words, even if there does exist an elusive material reality, one that remains consistent outside all human perception, and even if science represents the most accurate of all the fragmentary glimpses into a world unadorned with the baggage of subjectivity and history, there is no full untangling of scientific activity from human activity at large. The history of science itself, as well as political history, social

[49] Vogel, *Against Nature*, ch.1 & 2.

[50] György Lukács, *A Defence of History and Class Consciousness: Tailism and the Dialectic*, trans. by E. Leslie (London: Verso, 2000), p. 100.

organisation, theology, literature, the arts, etc., are not supplements to objectivity, but fundamental in its establishment.

This leads onto our central attention on scientific abstractions. A clear concern with scientific abstraction is invoked when Lukács asserts that:

> The specialisation of skills leads to the destruction of every image of the whole. And as, despite this, the need to grasp the whole—at least cognitively—cannot die out, we find that science, which is likewise based on specialisation and thus caught up in the same immediacy, is criticised for having torn the real world into shreds and having lost its vision of the whole (*HCC*, p. 103-04).

However, it is maintained that it is not science that creates this splintered outlook on the world, but rather a larger, reified rationality in society reflected in the institutions of scientific discovery. Consequently, 'The more highly developed [a modern science] becomes and the more scientific, the more it will become a formally closed system of partial laws' (*HCC*, p. 104). Equating the institution of formal laws with the status of science itself here is reminiscent of the energeticists' goal in unifying branches of modern sciences and delivering complete explanatory reduction. Lukács, however, refuses to reflect on the consequences of reification for the hard sciences, instead opting to critique the attempt of economics to replicate a formal science (something we will return to in §3).

A more in-depth treatment of the development of rationality is undertaken by Lukács in 'The Antinomies of Bourgeois Thought'. Principal in considering rationality is its ability to drastically change with the historical or material conditions of its emergence, and its given societal 'role'. However, as Lukács claims, 'What is novel about modern rationalism is its increasingly insistent claim that it has discovered the *principle* which connects up all phenomena which in nature and society are found to confront mankind. Compared with this, every previous type of rationalism is no more than a *partial system*' (*HCC*, p. 113, emphasis in original). Again, we are reminded of the often-explicit goal of the nascent modern physicists in searching for a unifying principle, one that 'claims to be the universal method by which to obtain knowledge of the whole of existence' (*HCC*, p. 114). The reification critique, therefore, implicitly reflects an anxiety with the universality of energy-rationality, and the hidden obligations with which it comes.

Imitation of the natural sciences also acts as a contributing factor in the process of reification, both in the reduction of all phenomena to abstracted laws, as well as taking on the cold, calculating role of the experimenter in interpersonal relations:

> What is important is to recognise clearly that all human relations (viewed as the objects of social activity) assume increasingly the objective forms of the abstract elements of the conceptual systems of natural science and of the abstract substrata of the laws of nature. And also, the subject of this 'action' likewise assumes increasingly the attitude of the pure observe [sic] of these—artificially abstract—processes, the attitude of the experimenter (*HCC*, p. 131).

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Now that we have traced within the original formulation of reification a potential critique of scientific abstractions, some proof is required that this indeed constitutes a useful ecological tool. Before investigating the damaging consequences of reifying abstractions, in this initial section it may prove useful to locate a critique of abstractions within the larger corpus of ecocritical theory. However, due to the sheer size of ecological theory and literature I do not intend to provide an overview of the discipline. Rather, a selection of ecocritical works are briefly sketched that are both paradigmatic of approaches and relevant to the current theory of abstractions.

From the discussion of science in Lukács, and the reference to the fractured world outlook it implements, one may conclude that an argument towards a more 'holistic' outlook is being made, which in turn suggests an affinity with the deep ecology movement. Deep ecology, a broad movement largely centred around the work of Arne Naess, distinguishes itself from 'shallow' environmental movements that seek conservationist principles only so far as they may prevent damage to humans, and therefore remain fundamentally anthropocentric. The basic principles of deep ecology consequently locate an intrinsic value in the systems of life itself, as preservation of the 'biosphere' is viewed vital for its own sake rather than for the maintenance or growth of human life—consequently, human populations are considered too high and must decrease.[51]

Indeed, the reified conscious could be diagnosed as an anthropocentric one. That is, a reified consciousness is one that only operates within the human-sphere (or perhaps only the patriarchal-human-sphere) by taking a calculating stance that *compresses* all our surroundings and ourselves into commodifiable objects, and therefore ignores the intrinsic value these surroundings may hold for 'others' (human or nonhuman).[52] The solution Lukács offers relies on a return to the totality of

[51] See, Arne Naess, *The Selected Works of Arne Naess, Vol. 10: Deep Ecology of Wisdom*, ed. by A. Drengson (Dordrecht: Springer, 2005), pp33-55, for an outline of the 'eight points' of deep ecology.

[52] This is a similar notion of reification forwarded in Honneth, *Reification*, pp. 52-63.

existence, an argument that could easily fit into the into the structures of deep ecology—perhaps even adding a needed socio-political dimension to a largely ethical field. However, it is this (philosophically) idealistic tendency in Lukács that is most fervently rejected.[53] Furthermore, although the reification critique is formulated here as an ecocritical theory of abstractions, the notion of *un-abstracted* thinking is not proposed as the alternative (even if, as may be the case, abstraction and ecology are considered antonyms). Whereas the solution to anthropocentric thinking in deep ecology is in switching to an 'ecocentric' stance, the harmful rule of abstractions cannot be solved merely by 'seeing the bigger picture'; but rather, as we shall see, by reaching into the viscera of abstractions to discover what they compel us to hold onto.

Social ecology, a movement often associated with Murray Bookchin, negates deep ecology by tracing the roots of ecological decimation into societal pathologies. The resolution of global warming, therefore, is a socio-political endeavour against the inequality inherent in capitalist production—yet ecological stability and sustainability is maintained as the foremost measurement of social change.[54]

Again, the reification critique could fit quite naturally into the framework of a social ecology. As reification, itself induced by the social organisation of industrial capitalism, in turn induces an anti-ecological stance towards the natural world. This is a perfectly reasonable interpretation and perhaps elucidates the influence of the Frankfurt School on Bookchin in its compatibility.[55] However, such a reading largely equates reification with the psychological condition of commodification; and the tracing of a connection between commodification and ecological damage appears to be the academic equivalent of shooting fish in a barrel. The current reading of Lukács's social theory is attempting to show how reification may operate beyond the realm of the individual, in making objects out of abstractions as a facet of the cultural impact of science.

An approach which could inaccurately be considered a variation on social ecology, and closer to my own approach with its largely theoretical focus, are those who investigate the flawed idea of 'nature' found in western discourse and its resultant ecological damage. Soper and Vogel are examples who also engage with Frankfurt School literature in committing to this approach. Soper engages with the cultural conceptions of nature to delineate how the border between nature and society/culture has been drawn along political lines, and to make the implicit political assumptions in the term nature explicit.

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[53] See, Honneth, *Reification*, pp. 21-28.

[54] Murray Bookchin, *The Ecology of Freedom: The Emergence and Dissolution of Hierarchy*, rev. ed. (Montreal: Black Rose Books, 1991)

[55] Murray Bookchin, *The Philosophy of Social Ecology: Essays on Dialectical Naturalism*, 2nd ed. (Montreal: Black Rose Books, 1996), p. ix.

Yet, she retains 'a realist position as offering the only responsible basis from which to argue for any kind of political change', and therefore upholds nature as an actual entity from which ethical practices can be derived.[56] Vogel pushes this argument further toward the position of strong social-constructivism, directly indebting himself to Lukács in an attempt to rid environmental philosophy of the term 'nature' altogether.[57] An alternative and popular variant of the 'nature-skeptic' position is forwarded by Morton, who reaches a similar conclusion to Vogel through a critical engagement with nature writing, romantic poetry, and 'first-wave' ecocriticism itself.[58]

These approaches indeed border on my own, as in many ways their engagement with nature could be viewed as assessing its appropriateness as an abstraction. Nature—as abstracting from an ambiguous range of phenomena ranging from trees, mountain vistas, yearly rainfall, to innate human violence—is reified into an object capable of operating well beyond its realm of application and with a certain ideological position. An idea of nature may be appealed to, for example in vetoing the implementation of wind turbines, in favour of oil dependence, in preserving the 'untouched' view of a landscape. Energy in its thermodynamic context is a more narrow and specific abstraction than nature, and is largely locatable within the realm of scientific literature (though early science fiction literature could figure heavily on the public opinion of energy[59]). However, I argue it can operate in the same vein even though it does not constitute a binary capable of deconstruction like nature and society, rather it necessitates the unpacking of its obligations to a specific outlook.

Ecofeminism is a broad field, in some formulations compatible with deep or social ecology but with added reservations. As hinted towards above, the anthropocentric thinking problematic to deep ecology may be re-theorised as *andro*pocentric. Alternatively, the societal domination instituting the root problem in social ecology may be specified as an inherently patriarchal form of domination. The approaches of ecofeminism, however, are highly manifold.

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[56] Soper, p. 8.

[57] Vogel, *Thinking like a Mall*, see ch.2. For a sustained constructivist reading of Lukács and the Frankfurt School, see Vogel's *Against Nature*.

[58] Timothy Morton, *Ecology Without Nature: Rethinking Environmental Aesthetics* (Cambridge: Harvard University Press, 2007).

[59] Such as the short story *Goliah* by popular author Jack London in 1906 about an anonymous, neo-Hobbesian figure who institutes a socialist utopia through a mysterious weapon named *Energon*, 'nothing more nor less than the cosmic energy that resides in the solar rays'; Jack London, *The Complete Short Stories of Jack London*, ed. by E. Labor, R. C. Leitz, and I. M. Shepard (Stanford: Stanford University Press, 1993), p. 1216. Goliah is an early and model example of the twin public conception of 'mechanical energy', as some*thing* that may bring unprecedented destruction and simultaneously a paradise to humanity.

Exemplary of an early ecofeminist approach to the cultural impact of science is Carolyn Merchant's *The Death of Nature*.[60] Merchant's text provides a historical account of how the development of modern science has resulted in the subjugation of nature and women. Asserting the need to review male theorists such as Descartes and Francis Bacon, she writes;

> In investigating the roots of our current environmental dilemma and its connections to science, technology, and the economy, we must re-examine the formation of a world view and a science that, by reconceptualising reality as a machine rather than a living organism, sanctioned the domination of both nature and women (Merchant, p. xxi).

Merchant's chapter on Francis Bacon, for example, is an exposition into how Bacon's 'new ethic' served to further an idea of progress tied to a patriarchal structure of state and family, as well as to the overall benefit of the nascent middle classes. This is evidenced by an inspection on Bacon's *New Atlantis* (1627), in which the conception of a utopian society exposes the underlying patriarchal assumptions behind the goals of the scientific revolution's control over nature: 'Bacon's Bensalem in the *New Atlantis* illustrated a patriarchal family structure in which the "Father" exercised authority over the kin and the role of the woman had been reduced to near invisibility' (Merchant, p, 173).

Merchant's appraisal of patriarchal science concludes with the holism of J.C. Smuts (a complicated figure, as a philosopher and South African war general in the apartheid era) as a proposed solution. As stated, the current approach does not wish to endorse holism, per se, as the solution to abstraction. The role of a patriarchal influence in the theorising of energy is not explored here, nor is the larger notion that abstractions are decidedly gendered. However, an (eco)feminist analysis could prove vital in assessing the cultural prioritising of certain scientific abstractions, as well as the feminist analysis of the scientific process itself in reference to 'situated knowledge.[61]

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[60] Carolyn Merchant, *The Death of Nature: Women, Ecology and the Scientific Revolution*, rev. ed. (New York: HarperOne, 1990).

[61] Important examples include: Evelyn Fox Keller, *Reflections on Gender and Science* (New Haven: Yale University Press, 1985); Helen Longino, *Science as Social Knowledge: Values and Objectivity in Scientific Inquiry* (Princeton: Princeton University Press, 1990). C.f. Donna Haraway, 'Situated knowledges: The science question in feminism and the privilege of partial perspective', *Feminist studies*, 14, 3 (1988), 575-99. Stacy Alaimo, *Undomesticated Ground: Recasting Nature as Feminist Space* (New York: Cornell University Press, 2000), provides a solid example of an ecofeminist redefinition of the association between women and nature.

1.3 Energetics↔Value↔Reification

Two years after the original publication of *History and Class Consciousness*, the English philosopher A. N. Whitehead conceived of a similar phenomenon to reification termed the fallacy of misplaced concreteness.[62] The fallacy dictates a propensity to make abstract ideas into concrete entities. This misplaced concreteness occurred particularly in the science and philosophy of the seventeenth and eighteenth centuries. Yet its effects, according to Whitehead, ran deeply into the intellectual outlook of the early twentieth century, only occasionally revealing itself through obfuscated symptoms, such as in the unending debates around the mind-body problem.

Does the (seemingly independent) emergence of the concept of reification and the fallacy of misplaced concreteness say something about a shared 'intellectual ontology' of the 1920s? An era largely dominated by the scientific outlook of physics, inspired by the emergence of the energy concept in the mid- to late- nineteenth century and its transition into nuclear territories, bringing with it visions of energy-abundant futures. Whitehead more likely had a firmer grasp of this transition, and certainly his work was more informed by the history and philosophy of science than Lukács's. However, Lukácsian reification can also be viewed as both a cause and consequence of nineteenth century physics, specifically the energy concept—a worldview that pervades our conception of fuel, our environment, and the capacity of our own bodies.

As we have seen, in the 19th century the incipient *scientist* found themselves in need of a binding agent able to hold together progressively fracturing fields of investigation.[63] Energy, therefore, emerged as a (meta)physical consistency, flexible enough to provide a foundational scientific cosmology. Consequently, the conservation of energy that swept the scientific community and general public's cosmological outlook was rooted in this desire for unification and tethered to the possibility of complete explanatory reduction.

Reification, in turn, can only exist as a valuable theory in this liminal space between realism and distortion. That is, between the acceptance of energy as existing in the world—as real as the observable phenomena that it underlies (i.e. against a bifurcation of nature in Whiteheadian terms)—and the ways in which energy becomes a concept through which we understand the world that we live in, organise practices and intuitions, and justify social circumstances. Essentially, in an ecocritical

[62] Whitehead, *Science and the Modern World*, pp. 64-92.

[63] For a history of the term 'Scientist' and its origins in unifying practices of physics, mathematics, chemistry, etc. in Victorian Britain, see Sydney Ross, 'Scientist: The story of a word' *Annals of science*, 18, 2 (1962), 65-85.

theory of abstractions, abstractions are real and causal agents; it is the assumption that abstractions are *not* real and causal agents, and are therefore politically neutral, that allows for their hijacking. (At the risk of sounding over-speculative, abstractions are 'emergent structures'). Subsequently, an ecocritical theory of abstractions should, as Stengers also notes, no longer attempt to ' "civilise" our abstractions, to separate them from their polemical power, but to transform them'.[64]

Therefore, the concept of energy itself is not a 'reification', neither is its acceptance as an objective feature of the universe. Rather, through investigating the history of the energy-concept we witness how societal practices culminate in the construction of concepts that morph and become influenced by 'internal' factors (within the field of physics, for example) and 'external' factors, such as the political organisations of industrial capitalism that revolve around energy production and consumption. The abstraction (energy) that emerges obliges us to its outlook; mechanisation, engines, unification, etc. The goal of an ecocritical theory of abstractions should be to 'transform' the obligations of energy in response to a warming planet.

At the turn of the 20th century, figures such as Wilhelm Ostwald were taking the establishment of the conservation of energy to initiate new schools of empiricism. This new 'school of energetics' looked at society and psychology as ultimately reducible to energy transfers, with 'value' being derived from efficiency in the process.[65]

Whitehead and Lukács, on the other hand, can be seen as (independently) posing theoretical alternatives to the fruition of a world conceivable in energy transactions. In their respective systems, the material realisation unfolding from energy in flux, i.e. the physical world around us, means that the subject finds themselves in the midst of continuing processes; yet may find this process obscured by the social practices of everyday life. For Lukács specifically, these 'social practices' both originate from, and maintain, the commodity exchange so prevalent in the process of modernisation—simultaneously justifying political systems that prevent social justice and a communist revolution.

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[64] Stengers, *Thinking with Whitehead*, p.113.

[65] Janet Stewart, 'Sociology, Culture and Energy: The case of Wilhelm Ostwald's "Sociological Energetics"–a translation and exposition of a classic text', *Cultural Sociology*, 8, 3 (2014), 333-350. The sociology of Ostwald, however, did not gain much traction, seemingly because of its almost brutal refusal by the most influential name in German sociology, Max Weber (another possible link between Lukács and the energeticists). On Weber and Ostwald, see Mark Mikkelson 'Translator's Note to "'Energetic' Theories of Culture" by Max Weber', *Mid-American Review of Sociology*, 9, 2 (1984), 27-31; Max Weber, Mark Mikkelsen, and Charles Schwartz, '"Energetic" Theories of Culture', *Mid-American Review of Sociology* 9, 2 (1984 [1909]), 33-58. There are interesting parallels between this energeticist approach and the theory of society forwarded by George Bataille: Allan Stoekl, *Bataille's Peak: Energy, Religion, and Postsustainability* (Minneapolis: University of Minnesota Press, 2007).

Taking or leaving the specifics of Lukács, we can conclude from him that transforming abstractions is not merely an intellectual endeavour, but concurrently political; in the following sections we will turn to other tracts of Critical Theory in expanding this.

The refusal to bifurcate nature, to *completely* discard the qualitative in the process of a reduction to energy, is key. We can observe this in the commercial distribution of energy itself, as Smil notes, 'Two kinds of coal may have an identical energy density, but one may burn very cleanly and leave behind only a small amount of ash, while the other may smoke heavily, emit a great deal of sulfur dioxide, and leave a large incombustible residue.'[66] The separation of energy and production in vast areas of western society allows for this form of qualitative difference to remain unimposing—as the meter shows kWh's, the lightbulb shines just as bright, the kettle boils just as fast, etc. The almost constant use of energy in our lives becomes an object in its own right, severed from the potentially dirty fuel that provides it, and the static feeling of our energy rich environment clouds the lens from which we view the world.

One may question how this argument is distinct from a holistic approach rejected above. Its divergence lies in refuting the prioritisation of the 'sum of the parts'—that the part can only be understood in the context of its whole domain—that remains inherent in the holistic approach and the deep ecology that runs out of it. This is partly because of a mistrust in the ability to pinpoint where a 'sum' exists, historically being employed without discomfort in the service of (eco)fascism.[67] Also because holism ignores that, as Morton puts it, 'it's all parts, all the way up and all the way down, so that a "higher level" (say, the relative height of trees in a forest) maps onto "lower" levels (say, the relative width of branches in a single tree)'; that is, it is not a possibility to *escape the abstraction* as a holistic position wishes to present us, but instead it is essential to map their interactions and obligations. [68]

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[66] Vaclav Smil, *Energy and Civilisation: A History* (Cambridge: MIT Press, 2017), p.17.

[67] For the fascist co-option of holism, see, for example, David Cooper, 'Verstehen, Holism and Fascism', *Royal Institute of Philosophy Supplements*, 41 (1996), 95-107. Lukács also pointed towards this in his expansive book *The Destruction of Reason*, trans. by P. Palmer (London: Merlin Press, 1980 [1953]), ch.4.

[68] Timothy Morton, *The Ecological Thought* (Cambridge: Harvard University Press, 2010), p. 106. The current is an approach inspired by an ecology of practices; see Isabelle Stengers, 'Introductory Notes on an Ecology of Practices', *Cultural Studies Review*, 11, 1 (2005), 183-96.

The connections between reification and energy are also expressed in parallel through their implicit reference to value. Simmel, for example, used the analogy of energy exchange in the physical realm in analysing the exchange of money in the *Philosophy of Money*.[69] Doubtless this connection could be meticulously traced into Lukács' formulations, but it may prove somewhat superfluous to do so: Wealth and energy have been equally influential (and reified) in their analogous entwinement with one other.[70]

A more meaningful connection is the metamorphosis of value that occurs with this analogy to the laws of energy conservation. This is especially important when considering that Marx's work expounding his often-called 'labour theory of value' is occurring precisely within this period of transformation. However, again, to attempt to derive Marx's precise position on the conservation of energy would be somewhat out of the purview of this essay, as well as appraising his disagreement with Podolinsky who attempted to synthesise a Marxist economic system with thermodynamics.[71]

Nonetheless, it is worth noting that the value metaphor that weaves throughout the first volume of *Capital* is one stuck between a caloric and mechanical theory. [72] The caloric/aether metaphor views value as a substance that flows from labour to other empty vases—commodities: 'As values, all commodities are only definite masses of congealed labour-time'.[73] This is contrasted with a view of labour as analogous to mechanical energy, as taking equivalence in the value generated in commodities. Yet Marx also wants to retain a qualitative value in the contextual manifestation of labour, the human being that enacts it, their beliefs and social practices that ordain it. We are flung back into the thoughts of Caleb Garth, who locates value in the process of labour itself rather than in the production of its output. Therefore, an ecological approach to Marx should be one that scrutinises

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[69] Stewart, p. 336.

[70] 'Abstraction or not, energy is as real as wealth—I am not sure that they are not two aspects of the same thing. The one drives the commercial and industrial activities of men, and the other the whole physical activities of the entire universe'; Frederick Soddy, *Science and Life: Aberdeen Addresses* (London: Murray, 1920), p. 28.

[71] Martínez Alier, and José Naredo, 'A Marxist Precursor of Energy Economics: Podolinsky' *The Journal of Peasant Studies*, 9, 2 (1982), 207-224; c.f., Paul Burkett, and John Bellamy Foster, 'Metabolism, Energy, and Entropy in Marx's Critique of Political Economy: Beyond the Podolinsky myth', *Theory and Society*, 35, 1 (2006), 109-156.

[72] Mirowski has outlined this possibility of conflicting value theories relating to heat theories; and distinguishes between a 'crystallised' labour theory of value (which possesses a strong conservation principle, remaining constant regardless of the market conditions), and a 'real-cost' labour theory of value, which is subject to the conditions of the market; Philip Mirowski, *More Heat than Light: Economics as Social Physics, Physics as Nature's Economics* (Cambridge: Cambridge University Press, 1989), pp. 174-185.

[73] Marx, p. 130.

labour as an abstraction, and indeed 'green' evaluations of Marx often criticise the prioritisation of labour for its inability to account for 'nature' or conservation.[74]

The similarities between Whitehead and Lukács also figure here, as they both suggest potentially important consequences in considering value as a substance or as a process. Whitehead's metaphysical system quite explicitly (although intricately and in a way largely avoidant of summary) rejects a substance view of the world towards that of process. Lukács, in turn, rejects the substance view of *society* for a procedural approach, a society 'constituted by fluid interactions between human beings at work and in the reproduction of their lives'.[75] This implies that, to Lukács, society is thermodynamic (or perhaps *value*dynamic), despite the rationalism of industrial capitalism that encourages its perception as something fixed and static: Where society becomes valued as the field in which commodities are produced and consumed, and nature (or an idea of it) becomes valued as the area not subsumed into society, clear landscapes and 'wilderness'. However, in a response to global warming this fixed account of value must be disrupted and made multifaceted in the deconstruction of a nature-society divide.[76]

Therefore, as we meditate on that 'myriad-headed, myriad-handed' thing energy, one wonders whether we must also still hear the 'roar of the furnace' or 'the thunder and plash of the engine' as necessary accompaniments to the energetic worldview. Or whether, as old values melt away, the practices inspired by the energy concept may become more multiple.

[74] See Huber, 'Value, Nature, and Labor'.

[75] Feenberg, p111.

[76] See Morton, *Ecology Without Nature*.

Section 2: Abstraction and Enlightenment

Section 1 has gone some way as to outline an ecocritical theory of abstractions. By an ecocritical theory of abstractions we mean an approach to culturally dominant (scientific) abstractions that engages with their historical and philosophical conditions of emergence in order to discover some of the underlying assumptions we may be obligated in when accepting the abstraction as a real entity in the world. We do not, however, wish to contend that abstractive thought must be reined in, or abolished, as an argument for holism and deep ecology would contend. Instead it is in the scrutinising of abstractions and their subsequent fluidity, as well as in the mapping of their connections and contradictions, that a decidedly ecological facet of this approach comes to the fore.

Reification and energy are both essential in this view rather than constituting mere examples. Assessing their interrelation has uncovered a responsive concern with the politics of abstraction, made explicit in Whitehead, yet brought into the realm of social organisation in the work of Lukács. However, so far little proof has been given that this approach could function as a critical methodology.

This second section will move forward in its route along the formulations of reification, onto the celebrated Critical Theory of Adorno and Horkheimer. In a selection of their co-authored and independent works, we find a pre-existing ecological critique that engages much more explicitly with abstraction and implicitly with reification; this will be explored and delineated.

Following this, a closer engagement with the methodological feature of Adorno and Horkheimer's theory of reification (their refutation of positivism) will be carried out through a cursory study of the conservation of energy as theorised by Ernst Mach and Max Planck, and speculating on some potential consequences of their 'opposing' views.

2.1 From Dialectics to Ecology.

> Presently the dry wood sent out a flame which illuminated every crevice, and Mary saw that the old man was lying quietly with his head turned a little on one side. She went towards him with inaudible steps, and thought that his face looked strangely motionless; but the next moment the movement of the flame communicating itself to all objects made her uncertain. The violent beating of her heart rendered her perceptions so doubtful that even when she touched him and listened for his breathing, she could not trust her conclusions. She went to the window and gently propped aside the curtain and blind, so that the still light of the sky fell on the bed.
>
> —*Middlemarch.*[77]

> Beneath the carving drag of wood
> the land moves slowly.
> But lightning comes.
> — Audre Lorde, 'Oaxaca', in *Coal.*[78]

The themes employed in the 1944 *Dialectic of Enlightenment* (DoE) embody a transition from the conservationist principles of Romanticism's appeal to nature, with its counterpart in the anti-Enlightenment philosophy of the nineteenth century, to a more expressly political project calling for near complete social transformation.[79] In attempting to diagnose the societal conditions that led to the spiralling emergence of fascism and oppressive capitalism, Adorno and Horkheimer collectively conceived of a speculative anthropology, one that poetically extols their respective concerns with mainstream culture and academic scientism. The exploratory text would assert itself as a centre-piece of 'Frankfurt School' thought; and with its impact in the emergence of social theory more generally, it can be seen as decisive to the ecocritical movement that would partially succeed it.

The relevance of the *Dialectic* in an ecological discourse is largely self-evident: 'What men want to learn from nature is how to use it in order wholly to dominate it and other men' (*DoE,* p. 4) writes

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[77] Eliot, p.354.

[78] Audre Lorde, *Coal* (New York: W. W. Norton, 1976), p. 10.

[79] Theodor W. Adorno and Max Horkheimer, *Dialectic of Enlightenment*, trans. by J. Cumming (London: Verso, 1997); abbreviated to DoE. For the similarities and distinctions between Marxist and Romantic critiques of modern society, see Micheal Löwy, 'The Romantic and the Marxist Critique of Modern Civilization', *Theory and Society*, 16, 6 (1987), 891-904.

Horkheimer, early in the chapter that defines the concept of enlightenment.[80] In doing so, he unabashedly explicates a plurality of claims on what nature is, how it manifests, and the fundamental role it plays is social organisation. The rest of the book, it could be said, aims at the dissection and reanimation of this statement.

The qualification for this process of domination comes with the swirling, dense style the *Dialectic* is famous for—a style called for in the denial of 'any allegiance to current linguistic and conceptual conventions', due to there no longer being 'any available form of linguistic expression which has not tended toward accommodation to dominant currents of thought' (*DoE*, p. xii). Perhaps a thorough reaction against the corruption of the German language under National Socialism, the *Lingua Tertii Imperii*.[81] Or perhaps more generally a preliminary argument about the entwinement of language and instrumental reason in reproducing complete technical domination. Regardless, greater lucidity can be gathered from analysing the chronology dotted throughout the text:

Pre-enlightenment, there exists a conflict between the individual and the sum of their surroundings that reveals itself through the endowment of supernatural status to the hidden and complex material networks that make up any given environment: [82]

> Everything unknown and alien is primary and undifferentiated: that which transcends the confines of experience; whatever in things is more than their previously known reality. *What the primitive experiences as supernatural is not spiritual, in contrast to material, substance; but the interwoven nexus of the Natural in contrast to the singular twine*. The gasp of surprise which accompanies the experience of the unusual becomes its name. It fixes the transcendence of the unknown in relation to the known, and therefore terror as sacredness. The dualization of nature as appearance and sequence, effort and power, which first makes possible both myth

[80] Habermas, with confirmation from Gretel Adorno, claims that Horkheimer primarily wrote 'The Concept of Enlightenment' and 'Juliette or Enlightenment and Morality'; and Adorno 'Odysseus or Myth and Enlightenment' and 'The Culture Industry' chapters. I will follow this claim for my own purposes. See Jürgen Habermas, 'Remarks on the Development of Horkheimer's Work', in *On Max Horkheimer: New Perspectives*, ed. by S. Benhabib, W. Bonss, and J. McCole (Cambridge: MIT Press, 1993), p. 57.

[81] Victor Klemperer, *The Language of the Third Reich: LTI, Lingua Terii Imperii: A Philologist's Notebook*, trans. by M. Brady (London: Athlone, 2000).

[82] Note that the concept, enlightenment, differs from the historical epoch and associated philosophers, the Enlightenment. Therefore, pre-enlightenment here is more analogous to 'pre-civilisation' than it is to 'before 1637'.

> and science, originates in human fear, the expression of which becomes explanation. (*DoE*, 15; translation modified[83])

Incipient abstraction, therefore, arises through an interaction between a vibrant nature and the construction of 'knowledge' at the dawn of civilisation. Here society is not organised by nature directly, as a vulgar materialism would posit, but rather becomes organised through an interpretive relationship between human knowledge and material nature. What is first taken to be a supernatural entity is not any sort of incorporeal essence, rather it is the inability to observe the entire entwinement (*Verschlungenheit*) of causal chains that make up the natural world, when observing—abstracting from—a single link (*Glied*) of that network.

The experience of nature is, therefore, as Caliban bemoans in *The Tempest*, an isle 'full…of noises'.[84] But not one of 'Sounds and sweet airs, that give delight and hurt not'—but rather one of a hectic calamity:

> All the infections that the sun sucks up
> From bogs, fens, flats, on Prosper fall and make him
> By inch-meal a disease! His spirits hear me
> And yet I needs must curse. But they'll nor pinch,
> Fright me with urchin—shows, pitch me i' the mire,
> Nor lead me, like a firebrand, in the dark
> Out of my way, unless he bid 'em; but
> For every trifle are they set upon me;
> Sometime like apes that mow and chatter at me
> And after bite me, then like hedgehogs which
> Lie tumbling in my barefoot way and mount
> Their pricks at my footfall; sometime am I
> All wound with adders who with cloven tongues

[83] ‚Was der Primitive dabei als übernatürlich erfährt, ist keine geistige Substanz als Gegensatz zur materiellen, sondern die Verschlungenheit des Natürlichen gegenüber dem einzelnen Glied'. Max Horkheimer and Theodor W. Adorno, *Dialektik der Aufklärung: Philosophische Fragmente* (Frankfurt am Main: Fischer Taschenbuch, 1988), p. 21. It is worth mentioning here that Cumming's translation splits opinion; Vogel, for example, quite heavily scorns it, whereas Jameson praises it. See; Vogel, *Against Nature*, p.184; Fredric Jameson, *Late Marxism: Adorno, or, the Persistence of the Dialectic* (London: Verso, 1990), pp. ix-x.

[84] *The Tempest*, Act III, Scene II, in William Shakespeare, *The Complete Works of William Shakespeare*, ed. by W. J. Craig (London: Oxford University Press, 1943), p. 10.

Do hiss me into madness.[85]

Culture, in the broad sense employed in the *Dialectic*, is the manifestation of a psychological need to suppress the fear induced by confrontation with the complexity of nature. In early human society, culture is entirely mythical.[86] Myth attempts, as rationality will, to reduce fear through the process of knowing: 'Like science, magic pursues aims, but seeks to achieve them by mimesis—not by progressively distancing itself from the object' (*DoE*, p. 11). The mythic hegemony in culture is therefore suffused with animism. However, with myth comes the strict hierarchy that would reach its zenith in *tribal* society, in some way itself mimetic of later feudal/absolutist rule. This hierarchy would stimulate a new form of self-preservation, in turn instigating reason in the need to disrupt and break down oppression. Conceptual-enlightenment, the expression of this emerging reason, therefore attempts to overcome fear for the same purpose as myth while employing its negation as a methodology: 'Man imagines himself free from fear when there is no longer anything unknown. That determines the course of demythologization, of enlightenment, which compounds the animate with the inanimate just as myth compounds the inanimate with the animate. Enlightenment is mythic fear turned radical' (*DoE*, p. 16).

'The disenchantment of the world is the extirpation of animism' (*DoE*, p. 5), which constitutes the primary tool of enlightenment. This process manifests in philosophy from the time of Xenophanes (who died 475BC) to the tropes of the early Analytic school of Russel and Wittgenstein—*qua* emblematic of the 'positivism' Horkheimer abhors.[87] Yet the rationality that disenchants animism also shapes a re-construction of the world, one that reflects its own reductive image: 'The subjective spirit which cancels the animation of nature can master a despiritualized nature only by imitating its rigidity and despiritualizing itself in turn' (*DoE*, p. 57).

However, this demythologization also contains the potential seed of enlightenment's demise and subsequent return to myth:

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[85] *The Tempest*, Act II, Scene II; Shakespeare, p. 14.

[86] Of course, this is an anachronistic use of the term *myth*, even by the standards of Adorno and Horkheimer. Myth can only thus be conceived as so if it stands at odds to the *reason* of enlightenment. As enlightenment comes from myth, it is clear that these two concepts are very much co-dependant. The deconstruction of myth and enlightenment forms a swelling undertone of the *Dialectic*.

[87] Generally, positivism refers a philosophical position in epistemology starting in the Positivist movement founded by Aguste Comte. Positivism stipulates the advancement of assured knowledge is exclusively derived from empirical observation, refined through reason and logic. However, this discussion confronts a discrepancy between Horkheimer's conception of positivism, and the beliefs of theorists commonly referred to as Positivists.

> Mythology itself set off the unending process of enlightenment in which ever and again, with the inevitability of necessity, every specific theoretic view succumbs to the destructive criticism that it is only a belief—until even the very notions of spirit, of truth and, indeed, enlightenment itself, have become animistic magic. (*DoE*, p. 11)

A potentially grim and pessimistic vision; as enlightenment attempts liberation from mythic-society and its corresponding hierarchy imposed from religious/spiritual leaders, the only effective process it can engage in is the destruction of all mythical connections to nature through rational abstraction. Thus, while enlightenment attempts to establish itself as separate from myth, its motivation for emancipation ultimately cannot justify itself in the reductive process of emancipation. Therefore, enlightenment itself only temporarily or superficially escapes the fate of extirpation—rationality ultimately leads back to hierarchy.

Accordingly, the process of enlightenment is the process of abstraction we have outlined; yet one that repeatedly prioritises itself to the destruction of its predecessor, until the emancipatory intent of its inception is also expelled. As the authors preface, enlightenment must 'accommodate reflection on this recidivist element', else it will 'seal its own fate' (*DoE*, p. xiii). This could be, and most straightforwardly is, read as an argument for a more holistic approach to nature. However, our attempt to resist the pull of holism instead directs us to the mapping of incompatible practices engaged with the environment around us—very broadly scientific and moral practices. Moral assertions such as those to social justice arise out of history, somatic experience, and claims to representation; whereas scientific confronts nature with the aim of a unified explanation. Moral life is also one resistant to translation into a unitary mode, but naturally exists as a multiplicity (see fig. 2).

Figure 2; William Blake's depiction of Urizen from The First Book of Urizen. Urizen, the representation of abstractions, god of reason and logic who rules over the Enlightenment, brings humanity into misery through uniformity:

> *It is Urizen. But unknown, abstracted,*
> *Brooding, secret, the dark Power hid.*
> *2. Times on times he divided, and measur'd*
> *Space by space in his ninefold darkness,*[88]

[88] William Blake, *The First Book of Urizen*, Copy A (London, 1794), p. 5. Image: Blake, *The First Book of Urizen*, p. 24; retrieved <http://www.blakearchive.org/copy/urizen.a> [accessed 25 September 2019].

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Horkheimer's chapter, 'The Concept of Enlightenment', inherits an overt concern with the methodology of science and epistemology, especially positivism, as expounded in his other key texts. The concern with positivism in *Dialectic of Enlightenment* is instantly evinced by the critique of Francis Bacon, a key Enlightenment reformer and ancestral figurehead of Horkheimer's positivism. Bacon is charged with leading the reductive, quantitative exclusivity of scientific method, as well as the encouragement of technical domination over nature in order to re-enter paradise following the Fall: 'Bacon's view was appropriate to the scientific attitude that prevailed after him. The concordance between the mind of man and the nature of things that he had in mind is patriarchal: the human mind, which overcomes superstition, is to hold sway over a disenchanted nature' (*DoE*, p. 4).[89]

Horkheimer initiates this concern with methodology and positivism in his 1937 delineation of Critical Theory, as opposed to 'Traditional Theory'.[90] Critical Theory attempts to solve the 'present crisis'; being both the inherent contradictions between a liberal society that treasures an ideal of individualism and liberty, while concentrating the majority of power and resources into an ever-smaller percentage of massive corporations (*CT*, p. xi); as well 'the incapacity of individual disciplines to give an epitome of the whole of actuality, providing instead only partial cognitions which are without relations to the whole of our existence'.[91]

These seemingly disparate crises both employ the exploitation of a purported rational thinking, such as science, in the justification of a pre-established order.[92] The social institution of science is invoked by systems maintaining unfair wealth distribution due to its ability to reflect contemporary society in a universal light, while also providing technological advances that benefit people. It is precisely the beneficial technological advances science brings that grants it such influence as a cultural institution.

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[89] Bacon has been the centre of subsequent ecological and postcolonial critiques: See e.g., Merchant, ch.7. However, Bacon's position as a historical figure has been complicated e.g. by those who indicate in him a trepidation towards colonialism; see Sarah Irving, ' "In a Pure Soil": Colonial anxieties in the work of Francis Bacon', *History of European Ideas*, 32, 3 (2006) 249-62.

[90] Max Horkheimer, *Critical Theory: Selected Essays*, trans. by M. O'Connel (New York: Herder and Herder, 1972); abbreviated to *CT*.

[91] Translated in Simon Jarvis, *Adorno: A Critical Introduction* (Oxford: Polity Press, 1998) p248, fn4. This latter formulation is the similar to the crisis found in Lukács above and Husserl; Edmond Husserl, *Transcendental Phenomenology: An Introduction to Phenomenological Philosophy*, tans. by D. Carr (Evanston: Northwestern University Press, 1970 [1936]).

[92] A project not dissimilar to Rousseau's first discourse, 'Discourse on the Sciences and Arts'; Jean-Jacques Rousseau, *Basic Political Writings*, ed. by D. A. Cress and D. Wootton (Cambridge: Hackett Publishing Company, 2012), pp.1-26.

Consequently, the sources of systemic injustice can become obscured by 'precisely those forces which are working for the betterment of the human situation' (*CT*, p. 4).

This stance is not anti-scientific, nor does it dispute the claims of modern science. The fact that the process outlined in the *Dialectic of Enlightenment* extends to well before the establishment of modern science is crucial in pointing out that the cultural privileging of reduction is one unrelated to the 'accuracy' of the findings it privileges. Positivism is therefore framed in a long line of theories that mistakenly privileges reduction as the only legitimate form of knowledge: 'To the Enlightenment, that which does not reduce to numbers, and ultimately to the one, becomes illusion; modern positivism writes it off as literature' (*DoE*, p. 7).[93]

This conflict with positivism would reach its zenith in the *Positivismusstreit*, a debate around the methodology of sociology occurring primarily between the Frankfurt School and other more empirically minded institutions.[94] However, the general critique was already very much present in the initial delineation of Critical Theory, viz. Critical Theory emphasises a heightened awareness to the historical impacts that continuously influence the (social or natural) scientist in their decisions, despite a feeling of immanent presence and objectivity in the investigation (*CT*, p. 195). It therefore identifies attempts to dismiss politically or historically informed accounts for ones that 'merely states the facts' as possible moves in justifying the liberal (or fascist) political dogma. Consequently, Critical Theory keeps only one primary influence as the object of research, a 'concern for the abolition of social injustice' (*CT*, p. 242).

We can observe in the delineation of Critical Theory, therefore, the transformation of abstractions under the guidance of abolishing social injustice. This acts in response to those who view abstractions as ahistorical and apolitical entities.

Unfortunately, the opposition of this overly rigid, ossified thinking has often opted to abandon science entirely by habitually exposing its inherent historicity or the oppressiveness of

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[93] 'For number is just that completely quiescent, lifeless, and indifferent determinateness in which all movement and relation is extinguished, and which has broken the bridge to the living element of instincts, manner of life, and other aspects of sensuous existence'; Georg W. F. Hegel, *Phenomenology of Spirit*, trans. by A. V. Miller (Oxford: Clarendon Press, 1977), p.172.

[94] See Marius Strubenhoff, 'The Positivism Dispute in German Sociology, 1954–1970', *History of European Ideas*, 44, 2 (2018), 260-76.

objectivity/universality.[95] As Stengers notes, 'Criticizing science's claim that nature can be discovered and described as independent of the perceiving mind or human language or culture, or as a mirror of nature, has been an easy sport for many philosophers since Kant';[96] a much more difficult task is mapping the obligations of a scientific outlook that allows for a legitimate exchange of ideas without devolving into scientism or dismissal, yet measures the boundaries of sciences compossibility with other outlooks. This is an aim of Stengers's ecology of practices and, concurrently, our ecocritical theory of abstractions.

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Adorno's succeeding fragment in the *Dialectic of Enlightenment* explores underlying psychodynamic mechanisms that operate in abstractive thought, as exemplified through his literary analysis of Homer's *Odyssey*. Adorno sees Odysseus as proto-bourgeois in that he undermines, and therefore destroys, the myth of his surroundings through the use of regulative reason—derived from knowing the inner workings of myth itself (*DoE*, p. 44). In other words, Odysseus uses a form of cunning to deceive myth, thereby bypassing its adherence and so benefitting himself. In this way, enlightenment emerges from the psychological need for self-preservation, and the use of sacrifice as a form of deception.

'Something of this trickery, which elevates the frail individual to the status of a vehicle of divine substance, has always been apparent in the ego—which owes its existence to the sacrifice of the present moment to the future' (*DoE*, p. 51). Here the image of Odysseus strapped to the mast becomes obliging. The sirens' song, with its irresistible alluring quality, ultimately dooms the sailors by drawing them onto the rocks. In the effort of self-preservation, Odysseus allows himself to hear the song, but restrains himself by being tied to the mast of the ship. When Odysseus comes in range of the song, his volition becomes undone, he wishes to give in to immediacy and follow the sound; the aesthetic splendour of nature. He calls out to his crew, their ears filled with wax, to follow his renewed orders. But in vain. They have been informed to ignore him until he no longer reacts to the

[95] C.f. Haraway, 'Situated Knowledges', who gives a witty account of the temptation in a feminist philosophy of science—with the emergence of strong social constructivism in scientific realms—to dispel all claims to objectivity and science as such:

> We unmasked the doctrines of objectivity because they threatened our budding sense of collective historical subjectivity and agency and our 'embodied' accounts of the truth, and we ended up with one more excuse for not learning any post-Newtonian physics and one more reason to drop the old feminist self-help practices of repairing our own cars. They're just texts anyway, so let the boys have them back (Haraway, p. 578).

[96] Isabelle Stengers, 'A Constructivist Reading of Process and Reality', *Theory, Culture & Society*, 25, 4 (2008), 91-110 (p. 93).

melody. His cunning, under allegiance to self-preservation, has outdone his desire for immediacy. He survives, and in so doing institutes sacrifice as the foundation of bourgeois rational reasoning.

Conceptual-enlightenment is partly constituted by this process of repression and self-alienation through cunning. Adorno's vision of humanity is one constantly beckoned by the 'nature' with which it was once unified. Abstractive thought, as the 'distancing' of the subject from the object through its reduction, represents the severing of this connection for the sake of survival. In this sense abstractive thinking is the foundation of instrumental reason, as in order to manipulate and control one's surroundings first they must be able to isolate the causal factors at play. However, for our current purposes Adorno's critique of abstractive thought represents a problematic appeal to a holistic and prior state of unity with nature, as reliant on the nature-society divide and the possibility of a non-abstractive thinking.

Adorno expands upon this notion of abstraction in his most explicitly philosophical work, *Negative Dialectics*.[97] In a negative dialectic, new attention is given to the way objects elude our conception of them. Objects, it is posited, are always more than the sum of their abstracted concepts; that is, they 'do not go into their concepts without leaving a remainder' (*ND*, p. 5). 'Identity' is Adorno's term for those features picked out from a perceived object necessary for it to be conceived of in thought. Other information about the particular that does not cooperate with our conception of them, the 'nonidentity', is ignored. This nonidentity has been categorically overlooked by the philosophical tradition, and therefore Adorno wishes to focus on hitherto unattended 'nonconceptuality, individuality, and particularity—things which ever since Plato used to be dismissed as transitory and insignificant, and which Hegel labelled "Lazy Existenz" ' (*ND*, p. 8).

Thus, as with our current approach, *ND* postulates that abstraction is required for the establishment and transmission of all concepts. The problem lies in mistaking the concept of an object for the object itself, i.e. giving primacy to the subject. Adorno sees this as present in early human self-reflection, and given gravitas by philosophic traditions from the Socratics to the German Idealists and beyond, evading even Marx's attempt at materialisation (*ND*, p. 244). This is a mistake that reverses the true nature of being, that people are themselves objects: 'It is not true that the object is a subject, as idealism has been drilling into us for thousands of years, but it is true that the subject is an object (*ND*, p. 179).

[97] Theodor Adorno, *Negative Dialectics*, trans. by E. B. Ashton (London: Routledge and Kegan Paul, 1973 [1966]); abbreviated to *ND*.

Thus, *Negative Dialectics* provides an epistemological clarification to *Dialectic of Enlightenment*, as well as an elaboration to its core propositions. 'The suppression of nature for human ends is a mere natural relationship, which is why the supremacy of nature-controlling reason and its principle is a delusion' (*ND*, p. 179). Thus, the root of enlightenment thought lies in the human cognitive disposition for reifying abstractions. In this way, abstraction is not only used to help identify patterns in the material world, but also acts as a tool in reducing the distress of confrontation with complexity, as mentioned above.

By way of an example, a field study by Suzanne Simard et al. found that underground networks of mycorrhizal fungi could transfer carbon between trees.[98] Older trees (specifically Douglas-firs) can transfer carbon to younger firs in order to aid their development.[99] The study evinced a level of interconnectedness in wooded areas previously unknown to us. In the complexity of a woodland, a single tree therefore represents a fragmentary abstraction. Nonetheless an abstraction that allows for its instrumental manipulation (i.e. felling it) by endowing the concept primacy over its material foundation (fig. 3).

[98] Suzanne Simard et al., 'Net Transfer of Carbon between Ectomycorrhizal Tree Species in the Field', *Nature*, 388, 6642 (1997), p. 579.

[99] Suzanne Simard, 'The Foundational Role of Mycorrhizal Networks in Self-Organization of Interior Douglas-fir Forests', *Forest Ecology and Management*, 258 (2009), S95-S107.

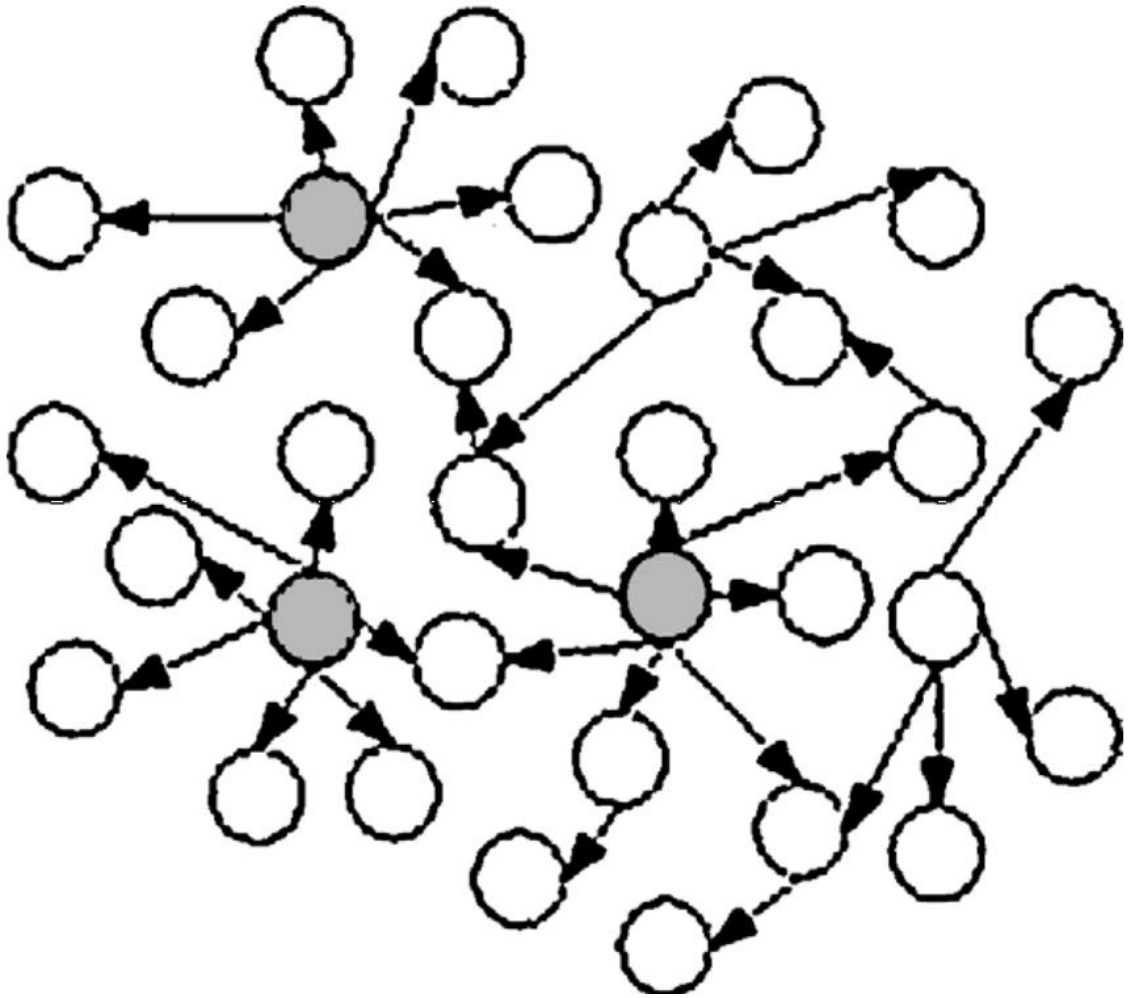

Figure 3: A representation of the connection between 'hub' trees (shaded) and neighbouring trees via networks of 'colonised' mycorrhizal fungi.[100]

And yet it is the material investigation of the world, science, that expands and destroys these limited concepts—not philosophical investigation. The example of mycorrhizal fungi therefore exposes a conflict in Adorno's philosophy between a distrust of abstractive thinking and a possible reliance on the material investigation made possible through it.

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The above analysis serves as an excavation. It has attempted to show through an analysis centred on the *Dialectic of Enlightenment* that the work of Horkheimer and Adorno already contains within it an

[100] Image retrieved from Simard, 'Foundational Role of Mycorrhizal Networks', p. S100.

ecological discourse that hinges on a concern with abstraction. In turn, their conception of reification, though still indebted to Lukács, is markedly different:

Firstly, the *Dialectic* affirms that the foundation of a particular 'civilising' rationality is intrinsically bound to an oppressive process. The abstractive methods of an emancipatory enlightenment, such as the distancing (through reduction and quantification) of subject from object, are enacted for the destruction of animism; the mythical approach to knowing the world employed to reduce the intimidating complexity of the natural world. In this way reification 'is a process that can be traced back to the beginnings of organized society and the use of tools', yet reaches completion in industrialisation with 'the transformation of all products of human activity into commodities'. Thus, reification closes the possibility of life organised around activities not productive or conducive to 'the maintenance and safeguarding of the general conditions under which industry can flourish'.[101]

The reductive rationality involved in demythologisation ultimately reveals itself to be an ouroboros, as the claims to social justice that inspired it are deemed unempirical and therefore redundant. This is most observable in the cultural acceptance of a 'positivist doctrine', a philosophical trend that, according to the *DoE,* reached its apex in the methods of investigation set out by Bacon, Comte, and later the Vienna Circle and early Analytic School. Positivism leaves legitimate claims to knowledge primarily to modern science, or at least to an idea of scientific methodology, and therefore fails to recognise somatic or speculative reflection as valid evidence for social change. Yet the positivist conception of both science and society are misleadingly short-sighted, for 'Modern science, as positivists understand it, refers essentially to statements about facts, and therefore presupposes the reification of life in general and of perception in particular'. The task of a non-reified philosophy should be one that looks beyond these 'surface phenomena that obscure rather than disclose the underlying reality', and therefore avoid confounding 'the congealed form of reality for a law of truth'.[102]

Negative Dialectics carries forward the notions set out in the *Dialect of Enlightenment*, providing an account that attempts to articulate the deficiency inherent in abstractive thought. The domination of nature begins with the mistaken belief that the objects perceived are the same as the abstracted concepts used to define them. Forgetting the deficiency of abstraction carries the processes of enlightenment forward: '…perennial domination over nature…[is] made possible only by the process

[101] Max Horkheimer, *Eclipse of Reason*, (New York: Oxford University Press, 1947), pp. 40-41.

[102] Horkheimer, *Eclipse of Reason*, pp.81-82.

of oblivion. The loss of memory is a transcendental condition for science. All *reification* is a forgetting' (*DoE*, p. 230, translation modified[103]).

As seen in §1.1, the abstraction of energy constituted an amalgamation of scientific experimentalism, mechanic-industrial worldviews, and a cultural desire for scientific unification throughout the nineteenth century. It represents the acme of abstraction in nineteenth century scientific thought. Yet the object being pinned to the cushion, the demystification through objectification, is transformation itself. Therefore, Adorno's account of reification appears very much concurrent with the reification of energy outlined in section 1.3, namely that the deficiency of the energy-abstraction is that it prioritises its consumption over the quality of its source, thereby implicitly sanctioning a complete dependence on fossil fuels, fracking, and other catastrophically harmful practices.

Yet the influence of positivism is not so easily imagined. Although the way that energy is construed, it will be argued, can exert an influence on the way it is portrayed culturally, alongside the ways in which the aesthetic quality energy takes can be exploited in the 'cleaning up' of the oil industry.

[103] Horkheimer and Adorno, *Dialektik der Aufklärung*, p. 244; ‚Alle Verdinglichung ist ein Vergessen'.

2.2 Positivist Constructions of Energy: Mach, Planck, and BP®

> Mammon, the least erected Spirit that fell
> From heav'n, for ev'n in heav'n his looks & thoughts
> Were always downward bent, admiring more
> The riches of Heav'ns pavement, trod'n Gold,
> Then aught divine or holy else enjoy'd
> In vision beatific: by him first
> Men also, and by his suggestion taught,
> Ransack'd the Center, and with impious hands
> Rifl'd the bowels of thir mother Earth
> For Treasures better hid. Soon had his crew
> Op'nd into the Hill a spacious wound
> And dig'd out ribs of Gold[104]

Although Horkheimer's narrative around positivism extends its emergence back into pre-history, his aphoristic use of the word is mostly in response to the popularity of the Vienna Logical Positivists in the early 20th century who, though also considered anti-fascists and socialists, are nonetheless considered 'as securely bound as metaphysics to the established order' (*CT*, p. 140).

The work of the Logical Positivists is vast and not easily summarised, yet perhaps quite telling is their shared dedication to a 'scientific world conception', which Neurath describes as 'empiricist and positivist: there is only knowledge from experience, which rests on what is immediately given. This sets the limits for the content of legitimate science. Second, the scientific world-conception is marked by the supplication of a certain method, namely logical analysis'.[105] Neurath's concept of a scientific world is therefore orientated around the unification of the sciences, mirroring the goals of Comte and Mach, through a collapsing of the material, psychological, and historical realms.

However, does this collapsing of realms lead to an 'incorrect' conception of the energy concept? Or, if such a statement is meaningless, does it lead to an approach to the energy concept that excuses ecological decimation through the erasure of variation? It seems unlikely that positivism could serve as Mammon, providing the conceptual foundations for an instrumental redefinition of the energy concept, and supplying it with those 'impious hands'. Especially considering energy's emergence

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[104] John Milton, *Paradise Lost*, (London: Penguin, 1996), pp. 26-27.

[105] Otto Neurath, *Empiricism and Sociology*, ed. by M. Neurath and R. S. Cohen (Dordrecht: Reidel, 1973), p. 309.

already thrown into the context of the 'industrial revolution', a by-product born of the fuel consuming engine.

In fact, in many ways positivism emerges as a result of the extreme influence of physics and its nascent school of thermodynamics in academic practice from around 1800 onwards. Nowhere is this more obvious than in the work of Comte, the founder of the Positivist movement, where the delineation of a 'social physics' seeks to directly imitate physics in outlining the study of society; sociology.[106] Ostwald too, with his social energetics, expands Rankine's science to the study of society and individuals in an almost paradigmatic case of the necessary expansion of ideology outlined by Adorno and Horkheimer.[107]

However, in order to observe whether this exploitation of scientific principles is a necessary consequence of positivism, it is valuable to analyse Ernst Mach's last report on the conservation of energy in 1894 as a key connection between the emergence of energy in physics and the positivist outlook that dominated the first half of the twentieth century (Mach was seen as a precursor to, and key influence on, the Logical Positivist movement, although he by no means exemplifies all the varying positions involved[108]). In this way we hope to show how the perception of abstractions necessarily alters the obligations they compel us to accept, and may consequently justify particular social practices.

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Mach expresses that 'after forty-seven years, the *law of the conservation of energy*, wherever civilisation exists, is accepted as a fully established truth and receives the widest applications in all domains of natural science'.[109] However, rather viewing energy as marking a conceptual revolution in the way we conceive of the world, one occurring in the process of mass industrialisation, instead 'people are led to see that the new view was long prepared for and ready for enunciation, only a few favoured minds had perceived it much earlier than the rest, and in this way the opposition of the majority is overcome' (Mach, p. 138).

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[106] August Comte, *Auguste Comte and Positivism: The Essential Writings*, ed. by G. Lenzer (New York: Harper & Row, 1975).

[107] See, Stewart, 'Sociology, Culture and Energy'.

[108] Paul Feyerabend 'Mach's Theory of Research and its Relation to Einstein', *Studies in History and Philosophy of Science*, 15, 1 (1984), 1-22.

[109] Ernst Mach, *Popular Scientific Lectures*, trans. by T. J. McCormack (Chicago: Open Court, 1898), p. 137-38, emphasis in original.

The discussion of the conservation of energy locates its conceptual antecedent in the impossibility of perpetual motion, as investigated by Simon Stevin and Galileo; before continuing onto the work in thermodynamics (inspired 'by the invention of the steam-engine, and by its great technical importance'; Mach, p. 160) that led more directly to the energy principle.

In the final section of the paper, Mach briefly discusses the energy principle through the lens of his positivist epistemology: 'All knowledge of nature is derived in the last instance from experience. In this sense they are right who look upon the principle of energy as a result of experience' (Mach, p. 179). The interdependency of sense-elements is evidenced by their simultaneity of occurrence, which leads to the observation of their connection without relying on contestable claims to cause and effect. The helpful analogy of a triangle is given, of which each angle will change with one another in preserving a total 180º without needing to know which angle is the one being manipulated. This complete primacy of experience ultimately leads to only one possible conclusion: 'In experience, therefore, is buried the ultimate well-spring of all knowledge of nature, and consequently, in this sense, also the ultimate source of the principle of energy' (Mach, p. 181).

The emphasis on the impossibility of perpetual motion that takes up the majority of Mach's account is required to establish the notion that energy is a perceivable entity in everyday life. This brings energy into the fringes of our entire perceptual experience. We can directly feel, whenever we move through and work in the world, the limits of our abilities—fatigue. The yearning for freedom from fatigue creates a fascination with perpetual motion, yet its perceived possibility is only a consequence of a confusion over more basic mechanical laws (fig.4), or intentional trickery.[110] The conservation of energy is the generalised idea that work or force cannot come from nowhere, it is therefore fundamentally bound to limitations.

[110] For example, Charles Redheffer presented his perpetual motion machine in both Philadelphia and New York City from around 1813 to 1820. It was exposed as a hoax, being controlled by a wire connected to a hand turned crank being turned by an old man in the room above.

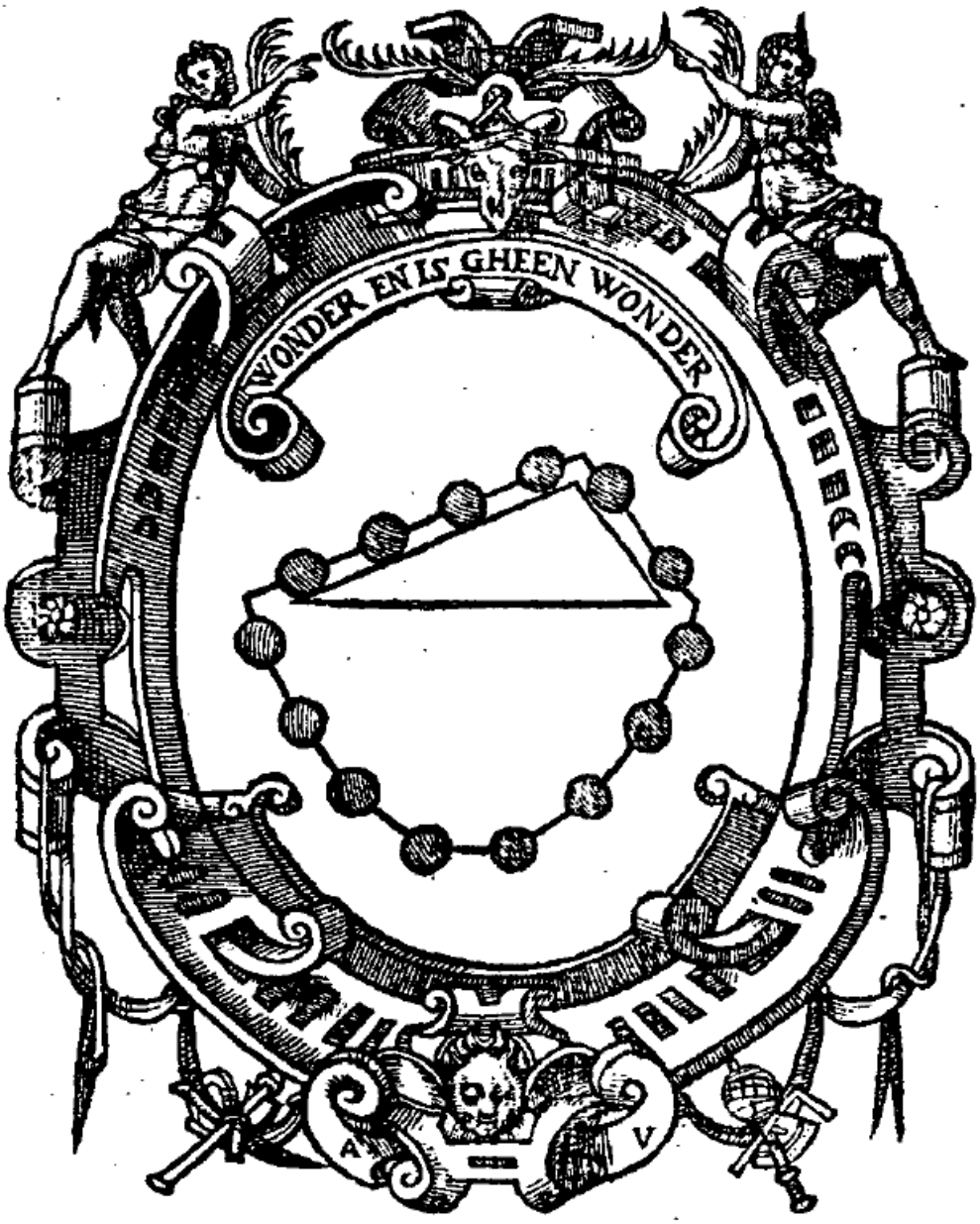

Figure 4: 'The Epitaph of Stevin'. The higher number of balls on the left side of the triangle creates the impression that the chain should continuously spin. However, Stevin, in rejecting the absurdity of perceptual motion, illustrates the ways in which the direction of force from the weight of the balls interacts with one another and the triangle. It has been suggested that Stevin's occupation and innovations as a bookkeeper formed a pre-held conception of the impossibility of perpetual motion and equilibrium.[111]

[111] Mirowski, p. 121; Michael Chatfield, *A History of Accounting Thought*, rev. ed. (Huntington: R. E. Krieger Pub. Co, 1977). Image retrieved from Simon Stevin, *The Principal Works of Simon Stevin, Vol. I; General Introduction Mechanics*, ed. by E. J. Dijksterhuis (Amsterdam: C. V. Swets & Zeitlinger, 1955), p. 47.

For Mach, therefore, the received wisdom that nothing comes for nothing may take many historical forms, but ultimately all act as less accurate prefaces to modern physics and the energy concept. His history of science situates energy as the most recent explanation in an ongoing investigation into the observed impossibility of perpetual motion, thereby giving no real significance to the historical context of European industrialisation. The explication given, therefore, despite its historical quality, is strictly depoliticised. This impression conflicts with even the brief historical account given in §1.1, and demonstrates a concrete example of the failings of positivism in analysing the progression of science. However, although I argue this is a mistake, the question remains as to whether it can be considered a reification.

Certainly, the positivist conception in Mach disguises the presence of transference and translatability fundamental to energy. The transfer in fuel use that occurred in the nineteenth century from a society primarily dependent on biomass to one reliant on the burning of hydrocarbons, coal in particular, is one that is paved with the labour and extortion of a working class population. At the peak of employment, British coal extraction in the 1920s required 1.2 million workers (7% of the total labour force); the sheer size of this industry was made possible through exploitative processes such as the use of child labour in the early eighteenth century and excessive deforestation.[112] The intense use of labour in establishing the coal industry represents:

> …an impressive example of how every transition to a new form of energy supply has to be powered by the intensive deployment of existing energies and prime movers: the transition from wood to coal had to be energized by human muscles, coal combustion powered the development of oil, and…today's solar photovoltaic cells and wind turbines are embodiments of fossil energies required to smelt the requisite metals, synthesize the needed plastics, and process other materials requiring high energy inputs.[113]

The emergence of the conservation of energy in the midst of this transition to coal signifies the period of 'power from any source', which the concept of energy accommodates for with its unifying influence. Labour and machine, coal and wood are made equivalent through the energy abstraction. It is not until confronted with the problem of global warming that energy fully reveals its frightening nonidentity. The transition to greener sources of energy indicates the termination of the period of power from any source, and thereby necessitates a re-conception of the energy abstraction.

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[112] Smil, *Energy and Civilisation*, ch.5.

[113] Smil, p.230.

The positivist conception cannot account for the transformative effect energy ultimately pertains to, as an analytic tool as well as a set of socially organised practices. In this way, Mach's account effectively brackets the interaction between subjective experience and conceptual abstraction: To Mach scientific abstractions such as the energy concept are ever-more accurate ways of differentiating what we already perceive, and therefore ignores how they may be hugely influential on the way we see the world and how we organise society.[114]

However, Mach's approach does not result in the reification of energy as the creation of *energy as energy*. The somatic-perceptual basis of scientific abstractions and concepts in Mach's philosophy fetters the energy concept to limitation rather than transformation, to fatigue rather than productivity. Thus conceived, unlike Marx's commodity, energy acquires little credence in its formation and, instead retaining the mark of its social dimension. That is, it does not appear so *objective*, and therefore cannot be used to justify socio-political regimes.

Therefore, in some ways the positivism of Mach in fact appears as force against the dangers of reifying energy—of treating energy as an object unto itself—even if it results in other unacceptable consequences. This becomes clear when examining the different ways in which Mach and Max Planck advanced the 'de-anthropomorphisation' of energy and energy conservation.[115]

Planck, insisted on the existence of physical concepts independently to human observation or theorisation, heavily criticising Mach in a series of attacking essays.[116] To Planck energy was the key to distinguishing physics from other disciplines, and therefore had to be proven to exist without philosophical scaffolding; 'thus, I could simply leave out everything which transgresses the strictly physical domain, especially the philosophical speculations, which have all too often been connected to the concept of energy'.[117] Also to the flames went all notion of any historical context of its inception. Rather, the *principle* of energy conservation is considered to be a real entity devoid of any human influence, and although Planck would not wish to endorse energy as a substance, in energy's complete de-anthropomorphisation it gains the quality of standing on its own feet, establishing physics at the summit of a unified scientific outlook.

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[114] See Rabinbach, *The Human Motor,* for the influence of the energy concept on a 'productivist' approach to economy and our own bodies.

[115] Daan Wegener, 'De-Anthropomorphizing Energy and Energy Conservation: The case of Max Planck and Ernst Mach', *Studies in History and Philosophy of Modern Physics*, 41, 2 (2010), 146-59.

[116] See essays collated in Stephen Toulmin, ed., *Physical Reality: Philosophical Essays on 20th Century Physics* (New York: Harper & Row, 1970).

[117] Quoted in Wegener, p. 148.

Planck's naïve realist view of energy is one of many ways in which energy can be instrumentalised in cleaning up fuel by removing it from its mode of production. This is well demonstrated by the 2001 rebranding of BP (fig. 5).

Figure 5: Spectres of Urizen? Top, the BP shield logo designed in 1920 by AR Sanders and used from 1989 to 2000. Bottom, the logo adopted from 2001 onwards.

The 2001 BP rebranding included its second name change from British Petroleum to Beyond Petroleum, with an accompanying aesthetic transformation of the company logo.[118] (Despite this suggestive change in name, it is worth noting BP continue to produce an equivalent of 3.7 million barrels of oil a day according to their website[119]). The older shield-shaped design is reminiscent of a purposeful industry; mechanical and engineering. Conversely, in the later logo, the green and yellow colour scheme is utilised in displaying a sunburst. Human artifice is removed to display the process of photosynthesis, the transition of energy from the sun to biomass. Consequently, the new logo intimates towards *energy as energy*. That is, any sense of an inherently industrial connection with the company is severed via relying on a (fictionalised) pure form of the energy concept.

BP continues to rebrand itself in ways that mask the process of its production, including the appropriation of community and diversity projects.[120] In this way, oil companies become ethically inclined 'energy companies', delivering a clean product to households and businesses—the relation between the burning of fossil fuels and the use of commercial energy is successfully masked by the reification of energy, enabled by a lasting 'realist' approach to its scientific history. After all, 'these companies have every reason to blur distinctions between fuels and energy. The more mystification the better'.[121]

An ecocritical theory of abstractions, therefore, must account for the obligations of how an abstraction is construed in scientific and visual culture. Yet the equating of positivism with reification in the work of Horkheimer and Adorno ultimately fails to account for all the ways that a scientific theory may become reified, as demonstrated by observing Planck's anti-positivism. It is not in our current interest to defend a particular outlook on scientific theory (realist, constructivist, positivist, etc.) instead it is emphasised that particular abstractions may be forwarded with differing ontological status depending on different intentions (e.g. unity vs priority in the case of Mach vs Planck respectively), and that these different statuses may oblige us in different ways.

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[118] The corporation had changed name from Anglo-Persian Oil—a reflection of BPs original role extracting oil from a large oil field discovered in Masjed Soleyman, Iran—to British Petroleum in 1954.

[119] <https://www.bp.com/en/global/corporate/what-we-do/bp-at-a-glance.html> [accessed 25 September 2019].

[120] Although, 'We want to build teams that reflect the communities we serve' is admittedly a more realistic promise than reflecting the communities they exploit: <https://www.bp.com/content/dam/bp/business-sites/en/global/corporate/pdfs/sustainability/group-reports/bp-sustainability-report-2018.pdf> [accessed 25 September 2019].

[121] Karen Pinkus, *Fuel: A Speculative Dictionary* (Minneapolis: University of Minnesota Press, 2016), p.3.

Section 3: Economic Orthodoxy and the Laws of Thermodynamics

An investigation into reification would in many ways remain incomplete absenting the transformation it undergoes in Habermasian theory. Hitherto, the reification critiques outlined have taken the form of two out of the three typical critiques of capitalism pointed out by Jaeggi: [122] A moral critique asserting that reification emerges out of the exploitative functions of capitalism and an ethical critique that situates reification as part of the general degradation of life and free thought. The mapping of these critiques with the energy abstraction draws out the way that the concept of energy may play a role in masking exploitation, or collapses theoretical alternatives to the capitalist crisis. This third section intends to situate reification and the energy abstraction within a functional critique—one that views capitalist organisation as systematically dysfunctional or corruptive.

As I hope to have shown in section 2, the theory of Adorno and Horkheimer fits quite naturally into an ecocritical theory of abstractions. In the most part this is due to the pre-existing 'environmental' argument that weaves through the *Dialectic of Enlightenment*, as well as Adorno's conception of nonidentity forming an alternative expression around the innate 'incompleteness' and fluidity of abstractive thought. The difficulty to overcome in their work, however, is the tendency to apply to a holistic argument. That is, deriving an ethical standard towards *Nature* and each other from a 'more complete' image of the entire causal nexus of our environment. This is an argument we have attempted to avoid throughout, for both its inherent impossibility and its potential for degeneracy.

The relevance of Habermas to our current project does not appear quite so intuitive. Firstly, because of a change of focus from epistemology to sociology in his work, where direct allusions to science and the prioritisation of certain knowledge *forms* give way for a more systematic theory of society and its failings. Secondly because nature, or some notion of it, no longer plays an active part in the analysis of society. Which, as we shall see, has created controversy over the ecological efficacy of Habermas's theory.

However, the Habermasian approach benefits greatly from its aversion of the holistic argument, as made explicitly in the delineation of a 'postmetaphysical thinking'. [123] Briefly, a postmetaphysical philosophy attempts an alternative to the totalising systems of knowledge offered by previous systematic philosophies (which Habermas also characterises as *identity thinking*), as well as rejecting

[122] Rahel Jaeggi, 'What (if anything) is Wrong with Capitalism? Dysfunctionality, exploitation and alienation: three approaches to the critique of capitalism' *The Southern Journal of Philosophy*, 54 (2016), 44-65.

[123] Jürgen Habermas, *Postmetaphysical Thinking: Philosophical Essays*, trans. by W. M. Hohengarten (Cambridge: Polity Press, 1995), pp. 28-53.

the total deconstruction and repudiation of rationality as commonly ascribed to the *postmodern* philosophies. Rather, philosophy must also situate itself in a socio-historical context and deny universality. I interpret this rejection of the 'metaphysical' philosophy—derived from the 'Ancient philosophy that inherits from myth its view of the whole'—as an outright rejection of escaping the use of abstractions by applying to a constructed 'bigger picture', despite the necessity to constantly transform abstractions. [124]

Section 3 starts with a detailed outline of reification outlined in Habermas's major work, *The Theory of Communicative Action*. I argue that the depiction of reification forwarded here can be read as attempting to delineate the appropriate abstractions for organising society and ethical life, which he takes to be a form of ideal communication. A new concern therefore arises as to whether the scientific abstractions that inform our understanding of global warming can be successively included in the process of social organisation. Therefore, this segment can be seen as an attempt to map an ecology of abstractions (or practices) and their obligations, as called for in preceding sections.

Next, we will look into the reception of Habermasian theory in an ecological or green context. This will situate our analysis in the context of a broader debate around communicative ethics and the crisis of global warming.

As we will see, the reification critique outlined in Habermas is one concerned with the over-extension of legal, bureaucratic, or market systems into the realms of life that frame communicative structures—what Habermas terms 'the colonisation of the lifeworld by system'. In the final chapter, this critique will be carried forward to analyse the influence of energy and thermodynamics on economics, and the colonisation of energy by the rationality of marketisation as constituting two possible forms of reification of the energy abstraction.

[124] Habermas, *Postmetaphysical Thinking*, p. 29.

3.1 Reification in *The Theory of Communicative Action*: Colonisation of the Lifeworld

The Theory of Communicative Action, split over two volumes, returns to the role of rationality in social organisation.[125] Here, however, in the effort to provide a secure perspective for social critique, Critical Theory is absorbed into the *linguistic turn*:[126]

> We would not be able to ascertain the rational internal structure of action oriented to reaching understanding if we did not already have before us—in fragmentary and distorted form, to be sure—the existing forms of a reason that has to rely on being symbolically embodied and historically situated (*TCA I*, p. xli).

This 'rational internal structure of action' is to be located within language and discourse since, according to Habermas's concept of *Universal Pragmatics*, 'Institutionally unbound speech acts owe their illocutionary force'—the intention of the speaker behind a given utterance—'to a cluster of validity claims that must be raised reciprocally by a speaker and hearer, and recognised by them as justified, if grammatical (that is comprehensible) sentences are to…result in successful communication'.[127] These intrinsic validity claims in language represent the 'existing forms of reason' that have been responsible for, yet heavily distorted in, the transition into modernity. The massive onus on discourse becomes apparent when Habermas states that language 'remains in a peculiar half-transcendence in the performance of our communicative actions and expressions, it presents itself to the speaker and actor (preconsciously) as a segment of reality *sui generis*'.[128]

Evidently, in drawing out the implicit structures of linguistic understanding, Habermas attempts to delineate an *abstraction* capable of informing societal organisation. Reification, therefore, takes on the form of a corruption or obfuscation of this abstraction.

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[125] Jürgen Habermas, *The Theory of Communicative Action, Vol.1: Reason and the Rationalization of Society*, trans. by T. McCarthy (London: Heinemann, 1984); *The Theory of Communicative Action, Vol.2: Lifeworld and System*, trans. T. McCarthy (Cambridge: Polity, 1987); abbreviated to *TCA I* & *II*.

[126] The linguistic turn commonly refers to an approach that investigated the relationship between language and reality, occurring primarily in the 20th century, and is characterised by 'the view that philosophical problems are problems which may be solved (or dissolved) either by reforming language, or by understanding more about the language we presently use'; Richard Rorty, *The Linguistic Turn: Recent Essays in Philosophical Method* (Chicago: Chicago University Press, 1967), p. 3.

[127] Jürgen Habermas, *On the Pragmatics of Communication*, ed. by M. Cooke (Cambridge: Polity, 1999), p. 88.

[128] Habermas, *Pragmatics of Communication*, p. 88.

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At the end of *TCA I*, Habermas states that Western Marxism has been mistaken in its prior conception of reification:

> The reception of Weber's theory of rationalization from Lukacs to Adorno makes it clear that the rationalisation of society has constantly been thought of as a reification of consciousness. The paradoxes to which this leads show, however, that this theme cannot be treated with the conceptual means of the philosophy of consciousness. (*TCA I*, p. 399)

Therefore, the concept of reification must be reformulated within the framework of communicative action and 'the formations of subsystems of steering media' (*TCA I*, p. 399). However, the description of reification given in *TCA I* implicitly suggests that the communicative approach and the reformulation of subsystems will attempt to synthesise (by way of providing a functionalist solution) Lukácsian reification with the more generalised reification put forward by Horkheimer and Adorno. The critique of instrumental reason as merely the extension of reification will be abandoned, instead the destructive instrumental reason explicated so magisterially by Horkheimer and Adorno becomes a consequence of reified subsystems. This allows the concept of reification to become, once again, a historically bound concept:

> Lukacs used the concept of reification to describe that peculiar compulsion to assimilate the interhuman relations (and subjectivity) to the world of things, *which comes about when social actions are no longer coordinated through values, norms, or linguistic understanding, but through the medium of exchange value*. Horkheimer and Adorno detach the concept not only from the special historical context of the rise of the capitalist economic system but from the dimension of interhuman relations altogether; and they generalize it temporally (over the entire history of the species) and substantively (the same logic of domination is imputed to both cognition in the service of self-preservation and the repression of instinctual nature). (*TCA I*, p. 379, my emphasis)

Here we can detect a somewhat generous reinterpretation of Lukács which aligns his position with the one to be explicated in *TCA II*. Again, a postmetaphysical thinking rejects the totalising component of Horkheimer and Adorno's position. A position which ultimately led, in Habermas' view, to the prompt abandonment of the programme of Critical Theory by Horkheimer, *qua* an 'interdisciplinary materialism' utilizing empirical sociology and epistemology (*TCA I*, pp. 385-386). This 'interruption'

in the task of Critical Theory, however, is to be resolved in *TCA II* through the systematic reintroduction of a communicatively bound rationality mediated through the 'system-lifeworld dichotomy'.

The lifeworld, a concept taken from the phenomenology of Husserl, is the symbolic sandpit that allows communication to take place. It ensures that in routine communication any new communicative situation can occur within a 'stock of knowledge that is "always already" familiar' (*TCA II*, p. 125). That is, the lifeworld includes any implicit (and explicit) knowledge necessary for communication or understanding to be reached from, e.g., from the specific geographical surroundings of the interlocutors attempting understanding to the linguistic and general cultural practices at large. The lifeworld therefore acts as the intermediary tools of communication between social-actors by allowing their corresponding subjective, social, and objective worlds to be discussed and disputed. It gives cultural and situational factors substance by making them functional, and by employing these factors in communication they are symbolically reproduced and thereby sustained.

Rationalisation of the lifeworld is considered a necessary product of modernity and is not lamented. In culture, rationalisation results in defiance to power-homogeneity in both aesthetic and moral realms, such as that enforced by the Christian-monarch-orthodoxy. In a given society, rationalisation may lead to the emergence of the legally-represented individual, that is, the notion of civil rights and justice.[129] In general, the rationalisation of the lifeworld shifts its shared concepts away from a justification in tradition towards justification from the *demos*; from the democratic process of discussion, deliberation, and understanding.

The question remains, however, whether a scientific quantification and explication of the mechanical processes in the world, as exemplified by the energy concept in physics, acts as a rationalisation of the lifeworld in any meaningful democratic sense. It certainly allows for democratic discussions around energy uses, production, and efficiency in deciding political structuring and re-structuring. However, in turn this demands a commitment to a particular worldview, with a similarly unnerving sentiment towards unification we saw expressed by the Victorian energy-pioneers. Which raises the question:

[129] *The Structural Transformation of the Public Sphere* [1962] is a historical, sociological tracing of this process; specifically, the development of the public sphere in European bourgeois society that allowed for open discussion of law and governance reliant on rational argument rather than power relations alone; Jürgen Habermas, *The Structural Transformation of the Public Sphere: An Inquiry into a Category of Bourgeois Society*, trans. by T. Burger and F. Lawrence (Oxford: Polity, 1989).

Does a democratically organised conservationist approach to fuel and biodiversity covertly require a monoculture in worldview?[130]

Habermas's answer may be only insofar as it replaces traditional power structures, as this democratisation of the lifeworld becomes possible precisely because rationalisation extends the 'scope of contingency for establishing interpersonal relationships' (*TCA II*, p. 146)—that is, by challenging traditional worldviews it opens up new space for action orientated by understanding. However, the space opened up in the disruption of tradition by rationalisation is competed for by the steering media of institutional-power and money.

As mentioned above, societies are conceived of as a concurrent system and lifeworld. *System* can be viewed as the culmination of existing societal organisations and institutions that substitute communicative action by guiding behaviour non-linguistically through utilising steering media. Features of system include law, bureaucracy, and markets. Pre-modernity, system and lifeworld are tightly interwoven structures that inform one another in the respective segmental differentiation involved in the division of labour. However, as the pressure placed on everyday language intensifies from the increased complexity and rationalisation of society in modernity, the system and lifeworld *uncouple*. This subsequently leads to system—and the instrumental steering media of money and institutional power it utilises to guide action—to excessively inform the lifeworld. This process, the *colonisation of the lifeworld*, is understood to be the causal factor 'behind the reification phenomena in advanced capitalist societies' (*TCA II*, p. 322).

The system and lifeworld dichotomy, however, is often harshly criticised, notably by Nancy Fraser. [131] Fraser incisively evaluates the distinction of system and lifeworld in reference to its ability to account for, and deal with, real social issues—namely a feminist critique—by showing that the system-lifeworld dichotomy, when delineated along occupational lines, necessarily excludes childrearing from the paid economy. However, I argue that it is only when drawing the system and lifeworld abstractions along either occupational boundaries or between realms of material (system) and symbolic (lifeworld) production that such pernicious obligations become relevant.

Habermas's use of builders as an example in elucidating the function of the lifeworld is very telling in this regard (*TCA II*, 121-123), as the influence of the lifeworld makes itself apparent in the labour of

[130] *Postmetaphysical II* largely centres around the notions of secularity and democracy, future research could look to elucidate this problem within Habermas's recent work in the philosophy of religion; Jürgen Habermas, *Postmetaphysical Thinking II: Essays and Replies*, trans. by C. Cronin (Cambridge: Polity Press, 2017).

[131] Nancy Fraser, 'What's Critical about Critical Theory? The case of Habermas and gender', *New German Critique*, 35 (1985), 97-131.

those more closely aligned with material reproduction; in the process of material reproduction motivated through systems steering media, the builders nonetheless communicate through the method in which, 'By drawing upon a cultural tradition, they also continue it' (*TCA II*, 125). This inherently suggests that it is not in the distinction between occupations of material reproduction (such as builders) versus occupations of symbolic reproduction (such as childrearing) that the system-lifeworld dichotomy operates.

Another critique Fraser puts forward is that Habermas neglects the patriarchal dominance that occurs in both system and lifeworld facets of society. This disrupts a notion of a 'pure' lifeworld corrupted by a malicious system, and remains a valid critique of Habermas' work, as he does very little to acknowledge feminist social issues in his delineation of society and the transition to modernity. It appears problematic for Habermas to write so extensively on modernisation while giving almost all volition to a dialectic between linguistic organisation and its corruption, yet very little to the subjugation and exploitation of minority social groups.

However, this does not mean the analysis of modernity Habermas provides is impractical in the service of social equality. Fraser herself draws on other aspects of *TCA* without alteration.[132] However, I believe she is mistaken in excluding the separation of system and lifeworld as potentially liberating abstractions, at least under the interpretation given above. For the co-existing patriarchy in system and lifeworld reinforces the view that feminist analysis ought not merely be orientated towards economic factors alone, such as equal pay and getting women into the workplace etc., but also towards uncovering how patriarchy is transmitted in the cultural and symbolic facets of the lifeworld in a way that subtly maintains male-dominance.[133]

*

If, as our analysis of Fraser has shown, system and lifeworld cannot be divided occupationally, our concern is whether they can be divided between concepts derived and accepted from scientific culture. That is, can a concept like energy be deemed only relevant for the lifeworld or system? And if so, is the reification of energy simply its misapplication in informing the lifeworld or system?

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[132] Nancy Fraser, 'Toward a Discourse of Ethic Theory', *Praxis International*, 5, 4 (1985b), 425-29; 'Women, Welfare and the Politics of Need Interpretation', *Thesis Eleven*, 17, 1 (1987), 88-106.

[133] The importance of material redistribution compared to that of 'recognition' is defended by Fraser in Nancy Fraser and Axel Honneth, *Redistribution or Recognition?: A Political Philosophical Exchange*, trans. by J. Golb, J. Ingram, and C. Wilke (London: Verso, 2003).

The answer, plainly, is that it is not—as the inclusion of scientific abstractions must ultimately influence both system and lifeworld simultaneously. The concept of energy from thermodynamics is influential in our shared lifeworld, it helps to reach understanding and organise practices. For example the expression ‘Turn off the light, it wastes energy!’ relies on at least a minimally technical notion of energy to make sense. Yet the energy concept also clearly informs the implementation and efficiency of systematic institutions, which in large part rely on the technical control of the applied sciences (and their implicit logic of productivity).

Herein lies the potential role of an ecocritical theory of abstractions, as although scientific theory cuts through the distinction of system and lifeworld, the concealed obligations in particular abstractions may facilitate the colonisation of lifeworld by system. Reification here may therefore provide a helpful framework from which to analyse scientific abstractions and the ways in which they exceed the boundaries of their applicability, or subsume other abstractions into them rather than mapping connections. A paradigmatic case of this, it will be argued in §3.3, has occurred with between thermodynamics and economics.

3.2 *Nature* as communicator; Habermasian Ecology

Before we apply the formulation of reification as the colonisation of the lifeworld to our concern with the energy concept, it is beneficial to outline the pre-existing work that applies and develops theories of communicative action in environmental politics. This will help locate our approach in distinction to others, and to contend an inherent ecological facet of the lifeworld.

Gunderson provides an overview of the debate surrounding the inclusion of Habermasian discourse ethics in an ecological philosophy/sociology, and suggests the break with Adorno and Horkheimer negatively impacted the acceptance of discourse ethics and communicative action in eco-theory.[134] To many theorists, Habermas' perceived neo-Kantianism falls into the same anthropocentric trap of the Enlightenment philosophy it attempts to reconstitute, as once again all volition is stripped from material nature and bestowed exclusively on humanity.[135]

Alternatively, Vogel suggests that the focus on communication allows for the full designation of nature to the social realm, which they diagnose as the core problem extending throughout Critical Theory since Lukács. That is, Critical Theory ultimately failed at attempting to derive ethical practices from nature whilst simultaneously maintaining the counter-notion that to do so was an impossibility and had resulted in the violent assuredness of fascism as well as the icy calculation and exploitation of industrial capitalism, much as our own arguments against holism have asserted. Vogel concludes that only humans can ascribe ethical judgments to nature, and therefore our interaction with the biophysical world must ultimately be determined through communication. [136] The problem with this view, however, is that it can never give a strong account to the environment.

Therefore, there are those who revise Habermas's original formulation of communicative action such as Dryzek and Eckersley.[137] Broadly, these theorists attempt to reformulate discourse ethics so that nature itself can play a role as a communicative interlocutor. Dryzek introduces the concept of *ecological rationality*, reached through the systematic reorganisation of society with an orientation towards ideal-speech situations. Although revising certain concepts is necessary to achieve this,

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[134] Gunderson, 'Habermas in Environmental Thought'.

[135] Joel Whitebook, 'The Problem of Nature in Habermas', *Telos*, 40 (1979), 41-69; and Robyn Eckersley, 'Habermas and Green Political Thought', *Theory and Society*, 19, 6 (1990), 739-776; 'Liberal Democracy and the Rights of nNature: The struggle for inclusion', *Environmental Politics*, 4, 4 (1995), 169-198.

[136] Vogel, *Against Nature*.

[137] John Dryzek, *Rational Ecology: Environment and Political Economy* (New York: Basil Blackwell, 1987); Robyn Eckersley, 'The Discourse Ethic and the Problem of Representing Nature', *Environmental Politics*, 8, 2 (1999), 24-49.

Dryzek argues that as communicative action is normatively disposed to generalised political interests rather than particulars (i.e. long-term goals rather than short-term politics), an ecological rationality focused on sustainability will necessarily emerge as the most general form of political interest.

Eckersley, on the other hand, wishes to change from an anthropocentric to an ecocentric ethical model, yet one still grounded in discourse ethics. This is achieved by taking the autopoiesis (the self-regulation of a balanced system) of an ecological system as representative of its intrinsic value and allowing that value-interest to be represented in a deliberative democracy. In other words, the intentions of an ecosystem are derived from what sustains its regeneration, and these intentions should be represented in the democratic process.

Brulle argues against Eckersley's amendments on both theoretical and political grounds to give the most ardent account of a non-revisionist Habermasian eco-theory.[138] According to Brulle, theoretical problems arise from the basic assumptions of autopoiesis (or systems) ecology: Firstly, systems ecology is presented as an outdated concept by ecologists, who reject this notion of a self-regulating model of nature in favour of an evolutionary model that presents nature in constant procedural adaptation. Deriving an ethical system from a self-regulatory nature, Brulle argues, advances a misleading certainty in establishing a telos, something at odds with contemporary ecological practice, or at least reliant on vague notions of stability and stasis. [139]

Perhaps more importantly, ethical systems based on systems ecology inherently endorses the nature-society divide, fixed natural concepts, and a static notion of human nature; the natural self-regulation is perceived as corrupted by the artifice of human behaviour. Furthermore, autopoiesis as an ethical system commits the is-ought fallacy, the deriving of normative sentiments from what there is (perhaps more accurately it asserts an appeal to nature, the problematic consequences of which punctuate the pages of *Dialectic of Enlightenment*).

Brulle's defence of Habermasian Critical Theory is in fact grounded in its inability, or unwillingness, to give a theory of value to nature. Ethical questions, such as 'what should we do?', are separated from moral concerns of who should be included in making ethical decisions and how this process

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[138] Robert Brulle, 'Habermas and Green Political Thought: Two roads converging', *Environmental Politics*, 11, 4 (2002), 1-20.

[139] Kristen Shrader-Frechette and Earl D. McCoy, 'How the Tail Wags the Dog: How value judgments determine ecological science', *Environmental Values*, 3, 2 (1994), 107-20. Brulle's representation of autopoiesis, however, is a crude one. It also ignores the possible influence of the concept on systems theory sociology and Habermas, directly or indirectly. For a short introduction to autopoiesis see Jakob Arnoldi, 'Autopoiesis', *Theory, Culture & Society*, 23, 2-3 (2006), 116.

should be realised. Consequently, Critical Theory can no longer provide an ethical account of how we should treat nature, but it does not block any theories of value that may emerge from political, cultural, religious or philosophical spheres. Ultimately, it aims at political action preventing ecological damage while avoiding any claim to privileged access about the world or nature—a conception very much in line with Habermas's project of postmetaphysical thinking, and our own.

We can see that generally the debates that surround Habermas and ecology seem to revolve around the ability to predict the intentions of nature, whether nature can be represented by looking at its fundamental qualities or aspects, and if not whether communication alone could account for the necessary restructuring of practices in diverting ecological destruction.

Yet communication, in Habermas' system or otherwise, does not occur in a rational vacuum, but rather appears as a consequence of branching physical systems from larynxes to landscapes. Therefore, as Dryzek suggests, free communication should intrinsically possess an orientation of preservation towards the physical systems it relies upon. The disruption of this orientation, however, is caused by Habermas's reformulation of reification—the colonisation of the lifeworld; therefore comprising the suppression of the inherently ecological facet of the lifeworld to the instrumental logic of system.

The lifeworld can become colonised by the logic inherent in fuel consumption. As Buell argues, inherent in the materiality of oil, its explosive extraction and obscene power capacity, comes the potential to over-rule the processes of reaching understanding with one another in subtle ways: 'Oil, once systematized, began transforming social life – sending out tentacles into people's private lifeworlds to change them in what seemed, to many (but not all), exuberantly positive ways'.[140] However, can the concept of energy itself and its obligations outlined in section 1 be exposed in a similar fashion?

[140] Buell, p. 283.

3.3 Energy as coloniser, energy colonised: Economics and Marketisation

In this final segment we will return once more to the reification of energy, with reification in its revised formulation as the colonisation of the lifeworld. I argue that the appropriation of the energy abstraction has been utilised in the colonisation of lifeworld, which in turn reinforces growth-orientated economic orthodoxy that prevents the necessary changes in the face of ecological collapse.

Firstly, the role of energy as a coloniser of the lifeworld will be investigated through the appropriation of thermodynamics by neoclassical economists. Then we will outline how energy has been colonised by it being constructed as an unproblematic commodity.

*

In 2018 Nordhaus William won the 'Nobel Prize' for *integrating climate change into long-run macroeconomic analysis*.[141] Yet one may refer to the following extract to get a sense of the economic orthodoxy that prevails throughout his work:

> The likelihood that people will be richer in the future is no excuse for ignoring climate change today. But it is also a reminder that we will leave our grandchildren a more productive economy alongside a degraded climate. If you compare the projected living standards in 2100 or 2200 …, you can see that it would take an enormous amount of climate damage to offset the fruits of future productivity growth on our living standards.
>
> Should we conclude from this example that our problem is too much economic growth? That we should aim for zero economic growth? Few people today draw this conclusion. It would be like throwing out all the groceries because the milk is sour. The appropriate response is to fix the market failure by repairing the flawed economic externality involved in climate change.[142]

[141] Officially the 'The Sveriges Riksbank Prize in Economic Sciences in Memory of Alfred Nobel', as Nobel did not actually set up an economics prize. It has been suggested by Mirowski that the Sveriges bank award has facilitated the rise of neoclassical economics; see the following interview, <https://www.versobooks.com/blogs/2290-what-is-a-nobel-prize-winning-economist-philip-mirowski-investigates> [accessed 25 September 2019].

[142] William Nordhaus, *The Climate Casino: Risk, Uncertainty, and Economics for a Warming World* (New Haven: Yale University Press, 2013), p. 82.

What is alarming about the above analysis is that it views global warming merely as an incidental economic (negative) *externality*—a cost which is not accounted for in the immediate price system or unintentionally incurred by a third party. Economic organisation and the uninhibited search for growth is absolved of responsibility, and the historical antecedents that entangle the producers of these *externalities* with the current theories of economics are buried under a series of mathematical projections.

The reception Nordhaus's account of global warming epitomises the influence of neoclassical economics in the field, an approach that, I argue, stands at odds with Habermas's social theory and even constitutes a case of reification by his account.

The functionalist-reification outlined in Habermas, when applied to the energy concept, unearths its role in the construction of a political process and outlook frequently referred to as 'neoliberalism'. As a popular phrase, neoliberalism has taken on a somewhat uncomfortably vague and polemical guise. In its general use, however, the term incites an overarching confidence in neoclassical economics and the expansion of individual rights within a liberal political system. Habermas eschews using the phrase neoliberalism in his diagnosis of society to give priority to a systematic outline of capitalist organisation, one that refuses to assume neoliberalism as a doctrine held by powerful individuals or a sheepishly misled public.[143] Instead, *TCA* emphasises interactions between societal institutions that form around an unrecognised system-lifeworld division, where institutions may consequently align in the subjugation of democratic processes. Therefore, in many ways reification *is* neoliberalism to Habermas; as the extension of the market-system into the realms of social organisation.

Mirowski outlines the historical reliance on conservation principles and substance theories in economics that were largely justified through their similarity to natural philosophy, later science, and physics in particular:

> …the most basic practice of reification in classical political economy was the postulation of a metaphor of value as a discrete substance in motion, created in production, conserved in the exchange of equivalents …, and destroyed in unproductive consumption.[144]

[143] Habermas points towards this in *Between Facts and Norms*: 'Money and administrative power are systemic mechanisms of societal integration that do not necessarily coordinate actions via the intentions of participants, but objectively, "behind the backs" of participants'; Jürgen Habermas, *Between Facts and Norms: Contribution to a Discourse Theory of Law and Democracy*, trans. by W. Rehg (Cambridge: MIT Press, 1996), p. 39.

[144] Mirowski, *More Heat than Light*, p. 176.

Yet the employment of value and physical motion as metaphors was bidirectional during classical political economy—as the notion of value played a direct role in uncovering and supporting positions in natural philosophy.

Neoclassical economics, however, rose to prominence during a period where physics was at a peak in influence, when the unifying implications of thermodynamics suggested a pathway for all disciplines to bask in its reflection. Whereas the cross-use of disciplinary paradigms can be indispensable in new formulations, the incorporation of thermodynamic formulas from physics into economics justified neoclassical formulations through association rather than any necessary comparison or even useful analogy. In short, neoclassical schools dispatched their competitors through a superficial application to the authority of physics and the energy-concept (Mirowski, p. 398).

Specifically, the so-called 'Marginal Revolution' of the 1870s approached the problem of commensurability of commodities by displacing the emphasis 'from external substances to the mind, [with] the mind portrayed as a field of force in an independently constituted commodity space' (Mirowski, p. 196). That is, marginal utility posits that the consumer will act in a way so as to maximise the margin of benefit or pleasure (utility) of a commodity over its cost. Therefore, value becomes a psychological desire that operates between commodities rather than something constituent of the commodity itself (i.e. labour), and arises in the process of exchange rather than use or production.

The founding-figures of this revolution (with the exception of Carl Menger), were all quite explicit in the necessary appropriation of the energy-concept in abstracting 'humanity' out of political economy in formulating a thoroughly mathematical depiction of economy. In the work of Irving Fisher, still taught as the canonical neoclassical model, the direct imitation of thermodynamics is clear (see fig. 3; Mirowski, pp. 193-275).

§ 2.

In Mechanics.		*In Economics.*
A particle	corresponds to	An individual.
Space	" "	Commodity.
Force	" "	Marg. ut. or disutility.
Work	" "	Disutility.
Energy	" "	Utility.

Figure 6: Table of corresponding translations between physics and economics from Fisher.[145]

The appropriation of thermodynamics in neoclassical economics attempts to naturalise its status, set aside from any influence of social practices and normative structures. The economic system becomes a scientific reality, something unable to be critiqued directly, but only managed and tamed. Economy becomes reified through an application to scientific thermodynamics.

And yet, the formulations of reification have also been critiqued for their inability to open up the 'black box' of the economy. Rahel Jaeggi points out how, in early Critical Theory, the expansion of the commodity structure into the realms of rationality (and rationality's subsequent disruption found in alienation, oppression, psychopathology even) leaves the specific economic practices of capitalism largely untouched. [146] Likewise, the Habermasian colonisation of the lifeworld actively maintains the notion that economic processes rule themselves. If Jaeggi's point is accepted, *TCA* details a communicatively organised intersubjective-lifeworld only to leave the economic structures imbued with an undesirable autonomy similar to the neoclassicists.

Jaeggi reiterates the necessity of understanding the economy in a *wider* sense through conceiving it as a set of 'social economic practices'.[147] As a set of practices (i.e. a form of life), economy can only exist and make sense against a backdrop of social meaning. Yet the embeddedness of practices related

[145] Image retrieved from Irving Fisher, *Mathematical Investigations in the Theory of Value and Prices* (New Haven: Yale University Press, 1926), p. 85.

[146] Rahel Jaegi, 'A Wide Concept of Economy: Economy as a social practice and the critique of capitalism', in *Critical Theory in Critical Times: Transforming the Global Political and Economic Order*, ed. by P. Deutscher and C. Lafont (New York: Columbia University Press, 2017).

[147] Jaeggi, p. 163.

to economy, such as what can be considered a commodity, means that a complete distinction is both impossible and misleading.

Economic practices, therefore, must be transformed alongside the social practices reached in understanding. 'The moment of crisis forces reflection on and adjustments of practices—a re-creation of practices—that were previously taken for granted'.[148]

Returning to our opening example of Nordhaus, it becomes clear that his refusal to recognise that the crisis of global warming directly confronts an economic system orientated towards continual growth represents a typical case of functional-reification. Abstracting the rules of economy, like a game of chess, the reduction of social change to the correcting of pesky externalities denotes the separation of economics from its embeddedness in the processes of society (global warming is, after all, a *social pathology*). The symbolic role of the energy concept, as we have shown, has made this reduction appear viable.

Economic organisation allows for one of the most powerful avenues of affecting social change. Yet as an institutional discipline economics feels inclined to award its own apathy. After all, the milk isn't just sour, the kitchen is on fire.

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Applying the lifeworld-reification to a critique of markets brings out some important similarities to Karl Polanyi's foundational work on marketisation, *The Great Transformation*, a historical evaluation of legal-economic fluctuations in marketisation and counter-movements throughout the long nineteenth century.[149]

Not unlike *TCA*, Polanyi notes that at times of heavy marketisation, 'Instead of economy being embedded in social relations, social relations are embedded in the economic system'.[150] This process is marked by the creation of certain 'fictitious' (reified?[151]) commodities—money, land, and labour—

[148] Jaeggi, p.167.

[149] Karl Polanyi, *The Great Transformation: The Political and Economic Origins of Our Time*, 2nd ed. (Boston: Beacon Press, 2001 [1944]). The similarities between Habermas and Polanyi has also been noted in Alexander Ebner, 'Marketization: Theoretical reflections building on the perspectives of Polanyi and Habermas', *Review of Political Economy*, 27, 3 (2015), 369-89.

[150] Polanyi, p. 60.

[151] Polanyi explicitly states: 'Marx's assertion of the fetish character of the value of commodities refers to the exchange value of genuine commodities and has nothing in common with the fictitious commodities mentions

which determine the political approach to marketisation. As legal regulations on these fictitious commodities become more relaxed, marketisation subsequently increases. Yet contradictions inherent in deregulating fictitious commodities create protectionist counter-movements, such as the Speenhamland system or the abandonment of the gold standard.[152]

I would argue to expand Polanyi's argument to include energy in the list of fictitious commodities. As since its inception as a scientific abstraction in Victorian Britain, energy has been reified into a commodity without considering the contradictions of doing so. As seen in §2.2, this has been achieved by reifying energy into a cultural object used to obfuscate the consumption of other commodities, fuels.

In Polanyi's analysis, inherent contradictions emerge out of the marketisation of fictitious commodities such as labour, for the complete abstraction of labour is impossible without *leaving a trace*, that of the human life attached to it: 'For the alleged commodity "labor power" cannot be shoved about, used indiscriminately, or even left unused, without affecting also the human individual who happens to be the bearer of this peculiar commodity'.[153] Fuel and energy are currently treated as a commodity in much the same way, in that they are regulated through market supply and demand processes. Yet this treatment is an inherently unstable process, as it assumes that the extraction and burning of fuel is inconsequential, and that fuel is something produced for sale rather than something that occurs, say, over millions of years in unmediated processes.

Marketisation that assumes the commodifiability of hydrocarbon fuel without consequence has been instrumental in the rapidly encroaching disasters of global warming. As disasters and global events in Polanyi's system spur on the counter-marketisation movements, it is ecological disaster (both looming and present) that will ultimately push for rebuking fuel as a commodity. And yet, when promises are being made for net-zero greenhouse emissions by 2050—requiring masses of renewable sources if energy consumption is going to remain anywhere near its current level—the potential ills of commodifying these new, clean forms of energy supply are yet to reveal themselves. [154] Part of the

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above' (Polanyi, p. 76, fn). However, as reification here is the creation of the commodity out of the immaterial, I believe the expansion of Marx by Lukács may be applicable.

[152] See, Fred Block, 'Polanyi's Double Movement and the Reconstruction of Critical Theory', *Revue interventions économiques*, 38 (2008), for a reinterpretation of this approach. For an outline of fictitious commodities, see Joy Paton, 'Labour as a (Fictitious) Commodity: Polanyi and the capitalist "Market Economy"', *The Economic and Labour Relations Review*, 21, 1, (2010), 77-87

[153] Polanyi, p. 76.

[154] Roger Harrabin, 'Climate change: UK government to commit to 2050 target', *BBC*, 12 June 2019, <https://www.bbc.co.uk/news/science-environment-48596775> [accessed 25 September 2019].

transformation of the energy abstraction, therefore, must be to remove its status as a commodity, and towards a notion of basic necessity.

Conclusion

> But first the notion that man has a body distinct from his soul is to be expunged; this I shall do, by printing in the infernal method, by corrosives, which in Hell are salutary and medicinal, melting apparent surfaces away, and displaying the infinite which was hid.
>
> If the doors of perception were cleansed everything would appear to man as it is, infinite.
>
> For man has closed himself up till he sees all things thro' narrow chinks of his cavern.
>
> --Blake, *Marriage of Heaven and Hell*, p.14.

The concept of energy will be indispensable in the fight against global warming, as the production, transportation, and efficient transformation of clean and responsible energy sources necessarily entails their quantified measurement. Yet, as the connection between fuel sources and culture is slowly unravelled, uncovering the obscured influences of an oil-electric capitalism, the cultural facet of science requires similar investigation.[155] This dissertation has attempted to outline some ways in which the energy concept itself has been complicit in the irresponsible practices and social organisations that have brought about the climate disaster, and the obligations that accompany the energy concept from its emergence in the science of European industrialism.

I have argued that the connection between social practices and rationality, inherent in the three approaches of Critical Theory from Lukács to Habermas, can be applied to the analysis of scientific abstractions. Reification, therefore, has been defined as a process through which these abstractions either exceed their scope of application, or become viewed as static entities that validate damaging practices, such as fossil fuel use. Consequently, the transformation of abstractions is not only possible but necessary, not by appealing to an idea of unabstracted reality, but rather by mapping the obligations of scientific abstractions against those obligations to social justice or an intersubjective rationality.

[155] Buell, 'A Short History of Oil Cultures'.

Necessary to this argument is the notion that—though perhaps the case with all abstractions—scientific abstractions covertly oblige us to their world outlook. This position is partly derived from Isabelle Stengers, who recognises the inherent political significance of scientific concepts and the importance of their trajectory through cultural realms:

> Once the neutrino, the atom, or DNA move away from the very specific site, the network of labs, where they achieved their existence, once they are taken up in statements that unbind existence, invention, and proof, they can change meaning and become the vectors of what might be called 'scientific opinion'.[156]

The Critical Theory outlined in this dissertation concurs with Stengers in the rejection of a unified scientific outlook. Therefore, an ecocritical theory of abstractions investigates the ways in which abstractions are not 'compossible', and shares with Stengers the intention of mapping their diversifying obligations and outlooks: 'No unifying body of knowledge will ever demonstrate that the neutrino of physics can coexist with the multiple worlds mobilised by ethnopsychiatry. Nonetheless, such coexistence has a meaning, and it has nothing to do with tolerance or disenchanted scepticism'.[157] Consequently, an attempt has been made to avoid the anti-scientific trappings often found in critical social theories, instead endeavouring to seek out the meaningful incompatibilities between energy and global warming; or even in suggesting to transform the energy abstraction as part of a radical re-conception in the transition to alternative fuels.

The obligation that the energy concept provokes is one of unification, of intertranslatability, and productivity—perhaps a consequence of its crucible in the nineteenth-century European scientific community. Regardless, energy's influence proved so great as to envelop the scientific practice it emerged within, providing the framework for those who wished to emulate scientific research in the realms of human psychology or society. These emulations by the 'human sciences' sparked rebuttals from Critical Theory, pointing out the palpable contradictions and insufficiency in such imitation. These rebuttals where originally intended to show the historical complexity and social responsibility inherent in the study of such abstractions as 'mind' or 'society'. I hope to have shown, however, that global warming has made the very same considerations necessary when studying scientific abstractions such as energy.

The sense that the theory of abstractions outlined is 'ecocritical' stems from its goal for uncovering the unecological practices that scientific abstractions may demand if left un-investigated and

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[156] Stengers, *Cosmopolitics I*, p.31.

[157] Stengers, *Cosmopolitics I*, p.vii.

untransformed. However, it is also in its acceptance of particular ecocritical ‘tenets’, such as an aversion to anthropocentrism and, perhaps more importantly, a rejection of the nature-society binary. Concurrent with this argument is a rejection of holism; that the sum is greater than its parts, or that ecology should necessarily replace abstraction. Rejecting the holistic approach has partly consisted in revealing its status as merely another abstraction, more ‘identity thinking’ in Adorno’s terms, one that has been used in justifying systems of thought from utopian socialism to fascism.

Critical Theory, together with Whitehead’s ‘fallacy of misplaced concreteness’, accepts the energy concept unreservedly but is weary of its prioritisation. Yet in rejecting the holistic ‘bigger picture’, the challenge becomes how to include claims to ethical, somatic, and historical social justice in the transformation of fluid abstractions. And with this, a question arises as to what a transformed conception of energy would look like?

The reification critique denotes the inherent contradictions in separating one’s own abilities such as ‘labour power’ from oneself, i.e. the impossibility of separating labour from the labouring body. I have argued that these same contradictions emerge in energy production. This suggests that a reformed energy abstraction would make some account for its source in fuel. Perhaps this is a rather limited sentiment, as it assumes that energy only denotes the energy market. However, it is precisely this limited aspect of energy that makes its reification possible. Energy is prioritised for its vagueness and intertranslatability over fuel, an abstraction that incorporates its extraction and the consequences of consumption.

We witness in the example of the BP rebranding this exact form of obfuscation. An appeal to the ‘cleanness’ of energy, pulling a green and yellow blanket over one billion three hundred fifty million five hundred thousand barrels of oil every year.

*

The reification critique inherent in Habermasian theory has also been conveyed as one concerned with abstractions. Namely, the delineation of the correct abstractions for social organisation, which Habermas takes to be the obligations in accepting an ideal communication paradigm. The colonisation of the lifeworld by system results in reification effects as communicative rationality is replaced by the instrumental rationality inherent in capitalist systems such as markets and law. Such a position is concurrent with the rejection of holism; it doesn’t apply to a ‘totality of existence’ that, for example, the market system subtracts from. Rather it concedes that the market outlook necessarily subsumes all into its field, commodifying everything from tables, to linen, to people, to planets. The abstractive

system that the market concept represents must therefore be mapped with other *incompossible* outlooks.

Which brings us back to our critique of economic orthodoxy, which never strays too far from Marx when he states:

> The folly of identifying a specific social relationship of production with the thing-like [*dingliche*] qualities of certain articles is what strikes us most forcibly whenever we open any textbook on economics and see on the first page how the elements of the process of production, reduced to their basic form, turn out to be land, *capital* and labour…this is a very convenient method by which to demonstrate the eternal validity of the capitalist mode of production and to regard capital as an immutable natural element in human production as such.[158]

Added to this here in the 'thing-like qualities of certain articles' is the energy-concept itself, as something immutable yet intertranslatable; economics treats all energy as a commodity regardless of its source, an equivalence which views the problem of global warming as requiring nothing more than the removal of the 'negative externality' that is complete ecological decimation. Reforming the energy abstraction will be removing its status as a commodity, even when a hypothetical transition to green fuels has been made, to prevent future contradiction.

Concurrently, the energy concept has been implicated in justifying the dominant economic paradigm of neo-classical economics. I argue that this is indicative of the obligations of intertranslatability in the energy concept, of the disregard for all other value than utility, that still exerts its authority over systems of economic opinion.

[158] *Results of the Immediate Process of Production*, in Marx, p. 998, emphasis in original.

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