

**THE INTELLECTUAL
DISCOVERY OF
HUMAN EXTINCTION**

EXISTENTIAL RISK AND THE ENTRANCE OF
THE FUTURE PERFECT INTO SCIENCE

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ABSTRACT:

Of late, risks of human extinction (or so-called 'existential risks') have become the target of an emerging field of scientifically serious study. We are now increasingly conversant with increasingly distal and severe futurities. Such a dynamic, of incremental entanglement with futurity, typifies the growing edge of modernity. Yet this dynamic is not itself without a history. Or, we have been being swept up in the future for quite some time now. This thesis attempts to supply the history of the incipience of this dynamic, by interrogating the Enlightenment bases and beginnings of our grasp of human extinction and existential risk. In so doing, it hopes to begin to supply a richly recollective dimension to the field of 'future studies'. Indeed, the story of how we came to be aware of our extinction invokes not only the history of rationality but also the rationality of history, inasmuch as recollecting the idea's Enlightenment provenance unveils study of X-risk to be a question of 'enlightening' in an integral and indissociable sense, which thereby contextualizes today's investigations on the topic as a vital continuation of the as-yet-unfinished project of Enlightenment and its tenacious task for the human race.

Accordingly, the thesis argues for the uniquely scientific and modern provenance of the idea of human extinction, as opposed to the perennial tradition of religious eschatology. In short, where apocalypse secures a sense of an ending, extinction anticipates the ending of sense. As different in kind, not degree, they are utterly different in origins.

Prospective grasp of our extinction first emerges, in the eighteenth-century, due to the maturation of three key scientific vocabularies. These included the emergence of the geosciences, the consolidation of demography and political arithmetic, and the development of a rigorous and mathematized notion of risk and uncertainty. Suitably, some of the first prognoses upon our extinction emerge from such fields.

Yet, these empirical vocabularies were necessary but not sufficient for the foment of future forecast concerning extinction threats. Grasp of existential risk didn't merely require breakthroughs in description of fact alone: it additionally demanded in-step reflections upon the propriety and position of value and reason as such. In other words, we had to first realize the cosmos isn't imbued with inherent justice and value, which required self-reflection upon the nature of normativity as much as ground-level empirical inquiries. Acknowledgment that our values would not be persistent and ongoing features of the natural world independently of our stewardship and guardianship of them was requisite before we could be at all motivated to preemptively protect them against an extra-judicial nature. In short, we had to discover that sapient value is cosmically precarious before we could appreciate that it was cosmically precious, and, through this, be summoned to the modernity-defining tasks of prediction, mitigation, and strategizing. This, then, was the incipience of our hyper-modern tendency to become incrementally entangled in the future.

Insofar as extinction therefore required philosophical reflection as much as empirical investigation, Immanuel Kant emerges as a key figure throughout. It was Kant, after all, who influentially defined Enlightenment itself as humanity's progressive undertaking of responsibility for itself: and it is the conviction of this thesis that today's increasing awareness and sensitivity to existential risk is just part and parcel of this still-ongoing task and trajectory. For, one is only responsible for oneself to the extent that one is receptive to the perils one faces, and, thereby, is in the first place motivated to become responsive to such hazards. And, in this sense, it ultimately becomes possible to contextualize today's emerging field of existential risk studies as consolidating from out of this progressive historical sweep, stretching all the way back to the Enlightenment and Kant's question 'What is Enlightenment?'

The conclusion, then, is that, in order to care about X-risks, we first had to separate 'fact' from 'value' so as to understand the stakes involved in the prospective 'fact' of the end of all 'value'. Only through this were we summoned to the tenacious tasks of forecast and foresight. And, ultimately, it is solely by undertaking such responsibility for ourselves, via acknowledging the utmost risk facing us, that we begin to earn security and hope.

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ABBREVIATIONS

PBS Percy Bysshe Shelley.

MWS Mary Wollstonecraft Shelley.

PU *Prometheus Unbound*, in *Complete Poetry of Percy Bysshe Shelley*. iii.vols (Baltimore: John Hopkins University Press, 2004).

QM *Queen Mab*, in *ibid.*

CPR *Critique of Pure Reason*. trans. M. Müller (London: Penguin, 2007).

CN *Coleridge's Notebooks*. v.vols (London: Routledge, 1957-2002).

CM *Coleridge's Marginalia*. vi.vols (Princeton: Princeton University Press, 1980-2001).

LM MWS's *The Last Man* (Ontario: Broadview Press, 1996).

INTRODUCTION

Mind may be at the end of its tether.

—H.G. Wells

The stakes are extremely large.

—S.D. Baum et al.

‘Unless the human species lasts literally forever, it will some time cease to exist’, writes Nick Bostrom of Oxford’s Future of Humanity Institute. In other words, ‘the long-term future of humanity is easy to describe: extinction’ [2009; 194]. Every moment is a dice-roll—and winning merely lets us keep playing—yet one only loses once [Čirković, 2014].

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According to the subfield of cosmology known as ‘physical eschatology’ (the science of long-term astrophysical processes such as entropy), the distant fate of intelligent life is ‘rather bleak’ [Čirković, 2004; 2]. At 10^{14} years old, the universe’s suns will have burnt out; by $\approx 10^{40}$ years, matter itself will have decayed, marking a ‘definitive end’ to biotic systems; post- 10^{100} years, even blackholes will have evaporated, leaving only purest darkness [Adams, 2008]. Intelligence, *of whatever kind*, will one day ‘cease to exist’ [Krauss & Starkman, 2000].

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Closer at hand, however, such certitude degrades into an ocean of near-term hazard. A ‘*growing swarm of risks*’ faces humanity as a planetary collective [Torres, 2017; 21]. Ranging from bootstrapping artificial superintelligence to neighbouring supernovae detonations—from weaponised pandemics to gamma-ray bursts—from world-destroying nanotech to universe-terminating ‘false vacuum collapse’,

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the list of ‘global catastrophic risks’ keeps growing [Bostrom & Ćirković, 2012]. Given proliferation of such dangers, Martin Rees, Astronomer Royal, ascribed *Homo sapiens* only 50/50 odds of surviving the incumbent century [2003].

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And yet, despite prevailing uncertainty, probabilistic reasonings from anthropic arguments and observer-selection effects—such as the Carter-Leslie Doomsday Argument or SETI’s Fermi Paradox—insist that, whatever we currently judge our odds, *they are likely significantly lower* [Leslie, 2002 & Ćirković, 2018].¹

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This expanding pantheon of so-called ‘existential risks’ (hereafter, ‘X-risks’) has, in other words, lately become object of an emerging field of serious, quantitative inquiry. The context for this is maturation of fields from astrobiology to machine learning, as well as pioneering work from scholars like Bostrom and Ćirković: as a result, ‘X-risk studies’ and ‘macrostrategy’ is, arguably, quickly becoming *the* most important academic discussion. Accordingly, we observe that the deep future—and speculative threats of an equally profound scale—have recently become the object of rigorous science-informed debate.²

¹ Regarding Fermi’s Paradox, Ćirković writes that the conspicuous lack of signs of spacefaring intelligent civilizations (dubbed the ‘*great silence*’) provides a ‘magic mirror’ within ‘which we can see the future of our own species’ [2018; 41].

² Torres avers that X-risk studies ‘is a thoroughly *scientific* discipline’: in that it observes the rigorous epistemic norms of science [2017; 59-60].

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This ability to ratiocinate upon our prospective extinction as a species has not always existed. In other words, this apex articulation of the unsurpassable historicity of human thought itself has a history. No-one, however, has yet supplied this.

In other words, there was a time before which people could *not* articulate or cognize ‘human extinction’, and a time after which they *could*: the following is the attempt to reconstruct the steps taken in-between, covering them through their multiple tributaries; from modal logic to political arithmetic, from actuarial science to palaeontology, from globalization to philosophical rationalism. A goal is to provide clarification of the conceptual groundwork and implicit conditions underpinning current-day ‘X-risk’ research, by way of articulating the genealogy of the premises involved: ergo, ‘historical retrospection’ as ‘theoretical future-proofing’.

Study of X-risks may have only very lately enjoyed institutional prestige, yet meditations on the topic (of a more or less rigorous nature) date from around the turn of the nineteenth century.

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Rewind two centuries, to October 1816. *The New Monthly Magazine* publishes an article frenetically listing various extinction scenarios [anon., 1816; 209-11]. The “aqueous fluid of our globe” is running out; the “thirty or forty thousandth deluge” is due. Elsewise, there is always the possibility of “general conflagration”, or, “general refrigeration of our globe”. The “generation” of all thinking beings “now living” will likely “be burned” and “our funeral pile will be kindled” by a desiccating planet. (Otherwise, the “moon is to fall upon us”.) Notwithstanding the mechanism, we can be sure that in around “[f]ifteen hundred years” the “globe will not be habitable” and “the world will be at an end for us at least”. And,

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should terrestrial life survive all this, the Earth will, “billions of centuries” away, “tumble upon the [Sun]”; and, eventually, all cosmic bodies are to become “*caput mortuum*” in one “huge mass of dross”.

The article glibly concludes claiming that the “amateur may take their choice” of extinction scenario, according to personal temperament. Yet, there is a thinly-veiled chagrin; the very ends of reason are at stake.

“Here, then, is a very rational end of the world!”, it closes.

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Despite chagrined flippancy, the article betrays a naturalistic grasp of humanity’s terrestrial precarity that was, at the time, thoroughly novel within public discourse. Extinction was a new idea.³ For, signposted by the use of “rational” in the provocation of a “very rational end of the world”, we immediately encounter the utterly non-theological and non-mythological pedigree of extinction. *Extinction, simply, is not apocalypse*. It is different in kind, not degree. Apocalypse secures a conciliatory sense of an ending; extinction anticipates the inconsolable ending of sense.⁴ The two are incompatible.

As differing in kind, they are also entirely distinct in origins.

³ The OED traces usage of ‘extinction’, as denoting a collective death, to 1602. Yet, here, it refers only to bloodlines, family lineages, or kingdoms: it cannot not yet refer to extinction as the terminus of our species, unique in its irreversibility. The former extinctions are historical happenstances, the latter extinction is the closure of history as such. The emergence of this latter connotation was combined and uneven: emerging first, in scattered scientific writings from the 1720s onward, yet it is only by the 1800s that it really captures public and widespread attention.

⁴ Apocalypticism, since Freud, has been associated with narcissism: i.e. the messianic *exceptionalism* of living ‘at the end’. (Blumenberg extended this to Hitler’s truncation of ‘world-time’ to his own ‘life-time’ [2001; 80].) In neat contradistinction, modern and sophisticated reasonings on X-risk utterly reverse this: the Doomsday Argument, for example, treats us as *entirely random selections* within the reference class of ‘all humans that will ever exist’, and then argues that—presuming population increase across time—it is more probable we are nearer the end than the very early beginning of this group [Leslie, 2002]. It is thoroughly premised upon assuming our *unexceptionality* as observers.

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Empirical evidences regarding extirpations of nonhuman species have been readily available since at least the Ancient Greeks [Mayor, 2000]. Fossils, in other words, have been recorded since Western civilization began. And yet, propositions ‘extrapolating’ from such anterior extirpations to our own prospective, future extinction emerge *only toward the end of the eighteenth century* (fully entering European public consciousness precisely around the time of the 1816 *New Monthly* article). This historical latency is testament to the extensive web of hard-won ancillary premises—of an exclusively inferential and theoretical nature—necessarily buttressing any proposition expressing ‘X-risk’ or ‘extinction’ as straightforward extrapolation from empirical data.

In other words, ‘X-risk’ is a question not just of straightforwardly abstracting from empirical intuitions, but also involves developing our grasp of our theoretical and semantic frame *upon* empirical data. Or, put differently, ‘extinction’ is a problem whose pedigree is, to a non-trivial degree, *philosophically implicated*—unavoidably so.

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My project, by consequence, has a dual-aspect. I am reconstructing not only a catalogue of the first explicit meditations upon X-risk and human extinction within intellectual history; but, in addition, we are simultaneously providing an in-depth and long-durational genealogy of the implicit philosophical conditions underwriting our modern cogency of such threats. One side is a *de facto* historical timeline of X-risk locutions; the other establishes their *de jure* conditions of possibility.

‘How is it that reason reasons upon its closure?’, I enquire; it turns out, as we shall see, that articulating extinction is, after all, “*very rational*”.

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All of the expressive and conceptual modules requisite for enunciating X-risk converge and aggregate, inchoately yet conspicuously, during the Age of Reason. It is only suitable, then, that the harbinger of the age, Immanuel Kant, himself became increasingly occupied with human extinction as he matured.

In 1798, during an essay enquiring into whether the progress of our species will be indefinite and ongoing, the Sage of Königsberg's speculations upon perfectibility are arrested by a chilling plausibility: that of "*Naturrevolution*". Anthropoc history, Kant calculates, will continue, unless there occurs an "epoch of natural revolution which will push aside the human race to clear the stage for other creatures" [1979; 161]. Starting from the third critique's reference to "nature's most ancient revolutions" in 1790 [1987; 305], Kant became increasingly preoccupied with such projections [Fenves, 2004.; 6]. By the writing of his *Anthropologie*, he imagines primates becoming sapient and replacing humanity [2006; 232-3]. In 1795's *Towards Perpetual Peace*, Kant accuses humanity of being a "race of devils" due to our perennial corruption: and, even more disturbingly, the quintessential cosmopolitan idealist claims that it is possible that his titular "perpetual peace" may be consummated "only in the vast graveyard of the human race" [1991; 96]. Accordingly, in his final work, *Opus Postumum*, an elderly Kant claims that "human beings, as rational beings, exist for the sake of other human beings of a different species (race), which stands at a higher level of humanity". Equivocal though this phraseology is, Kant instantly relates it to the "*Erdrevolutionen*" and catastrophist "*Weltepochen*" that have previously called forth and "differently organized creatures, which, in turn, make a place for others after their destruction" [1993; 66-7].

Ever sensitive to “revolution[s] in the air” [Fenves, 2003; 137], Kant is seen, across these episodes of presentience, to be progressively swept up in modernity’s tendency to increasingly entangle us—both theoretically and practically—in an ever-deepening horizon of futurity.

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From financial futures markets to global climate simulations, we—residing in the early twenty-first century—live in a ‘culture of prediction’ characterized by incrementally long-range and high-resolution models [Heymann et al., 2017]: a growing ‘integration of the future into the present’ demanding of modern citizens the consequent aptitude of ‘futures literacy’ [Miller, 2018; 2]. That is, we are all progressively conversant, in the present, with a growing suite of progressively distal and severe futurities. Such conversancy, which we hereafter dub ‘future-orientation’, can be schematized along the lines of a *feedforward responsivity* to salient future outcomes.⁵ In popular discourse, this relationship is most commonly incarnated as one of ethical obligation: our horizon of deontic culpability—by way of anthropogenic climate change—now encompasses indefinite posterior generations. Bostrom [2003 & 2013] has spelled out the mind-bendingly ‘astronomical’ catchments that such reasoning tends toward.⁶

⁵ This follows Rosen’s definition of an ‘anticipatory system’ as any ‘system containing a predictive model of itself and/or its environment’—allowing it to course-correct and optimize present behavioral stratagems based upon future-orientations [2012; 313]. Rationality, then, is paradigm exemplar of such a system (now at a global scale [Bratton, 2016]). Notably, resultant mitigative strategies ‘often lead to endogeneity or reverse causality’ wherein anticipated outcomes ‘alter current behavior so that some sense of the future causes the past’ [de Mesquita, 2014; 481]. We return to this later.

⁶ Bostrom famously noted that, should humanity persist deep into futurity and colonize other planetary systems, trillions upon trillions of humans may exist and, thus, our obligation to these potential future generations (alongside the gargantuan weight of their aggregate potential life worth) is *astronomically high*. Through this, Bostrom contends that, on any coherent utilitarian grounds, mitigating X-risk is *the* most important human issue.

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The future perfect mood—e.g. ‘*it will have happened thus and so*’—is, as Bexte wagers, ‘the dominant symbolic form in which the present age will have characterized itself’ [2011; 226].

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Gramelsberger, similarly, writes of the recent shift from ‘science’ to ‘computational science’, attendant upon

the evolution of the inductive-deductive mode of 17th and 18th century research, via the hypothetical-deductive research style of 19th and 20th-century science, into the [future perfect] mode of today’s science—a mode that introduces the new propositions of “*it will have happened*” into scientific research. This future perfect proposition incorporates a complex temporal structure that precludes validation in traditional ways.

This new program ‘challenges scientific self-understanding’ insofar as such future perfect propositions ‘are intended to be prevented rather than being used to validate hypotheses’ [2011a; 20].

Despite folk tendencies of dismissing deep-future speculations as ‘science fiction’, such forecasts are now increasingly integrated into ‘normal science’ [Winsberg, 2010]. This, of course, is the shift within which the recent baptism of ‘X-risk studies’ should be contextualized; yet, as Gramelsberger amply implies, the entrance of the *futur antérieur* into science traces roots long prior to the uptake of the computer itself.

Koselleck, indeed, decreed that ‘modernity’, as a temporal organization, is defined by increase in ‘demands made of the future’: thereby motivating development of scientific forecast [2004; 3]. Following this, we note that—keyed into capitalism’s concomitant lowering of ‘time-preference’—a heightening of ‘future-orientation’ defines not only our own ‘computational’ moment within late modernity but, moreover, *modernization as such*.

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Hence, therefore, we embark upon elucidating the long-range conditions of this contemporary paradigm shift to future perfect modes.

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As Gramelsberger’s comment on ‘prevention’ reminds us, the matter is not all ‘doom and gloom’: far from it. Risk assessing, after all, is indispensable to flourishing. Again, this is why prognosing the end of reason is, in fact, “very rational”. “Rational”, that is, in the precise sense of *undertaking responsibility*: an epistemic act that Kant identified with “*Aufklärung*”, or ‘Enlightenment’, itself. This, then, is why becoming sensitized to the potential for our own extirpation, and the precarity of our human project, is a cardinal (and possibly unparalleled) accomplishment of self-legislating rationality itself. Assuming absolute stakes is the requisite collateral of undertaking totalized culpability for one’s project.

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Indeed, throughout, we leverage a broadly Kantian lens regarding the material of intellectual and scientific history. More precisely, our theoretical optic is coloured by the naturalistic and science-friendly reuptake of ‘Kantian themes’ initiated in Anglophone philosophy by the work of Wilfrid Sellars (and continued today through his students, e.g. Robert Brandom). Such a Kantian backdrop is paramount because the story of our sensitization to existential threat is uniquely exemplary of the dialectical process whereby it is solely through elaboration of, and negotiation with, the ineliminably *artefactual* aspects of our cognitive frame that we come to better grasp the natural world independently of said framework and, thus, advance the wider project of *naturalization* (and, what’s more, further

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triangulate cognition's—ultimately mutable—position within nature). *Only by de-naturalising mindedness do we consequently naturalise it.* It is exactly this dynamic that the post-Sellarsian transposition of Kant allows us to make sense of. Enabling us, that is, to understand the fact that 'naturalization is really a second-order semanticisation' [Floridi, 2017; 283-4].⁷ Historically speaking, it is only through Kantianism's non-naturalisation of key aspects of our cognitive frame (classifying them, not as supernatural or transcendent, but as 'transcendental') that we could accordingly imagine the senescence (i.e. extinction) of cognitive contents within nature *without* also imagining a coeval destruction of widest nature itself (as is the case in apocalyptic scenarios). Only Kantianism, that is, first allowed 'extinction' to become legible as a disaster of *exclusively* semantic and normative scope—as a paroxysm solely concerning the conceptual sphere of reasons and values—thusly enabling coherent prognoses on nature's *post-festum* regularity and permanence after humanity's lone departure.

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Through this, an auxiliary aim of ours is to illuminate deep-running filiation between 'risk' and 'reason'. 'Rationality', that is, is not the 'secure ground' that provides irrefragable insurance against fallibility; rather, 'rationality' is eternal course-correction, readjustment, and self-amendment; jeopardy, as such, is not expungable *apropos* assertions of knowledge but, rather, is *the very medium* of making and staking truth-apt propositions.

⁷ Thus, additionally accounting for 'why science is increasingly artefactual' and why the 'naturalisation of the non-natural turns out to be an expression of the artefactual nature of the natural' [Floridi, 2017; 283-4].

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Kant, accordingly, pictured human reason as a vessel in a hazardous ocean. Where Hume's surrender to the circumspect solidity of habit betrays him as running his "ship ashore, for safety's sake", the critical project instead embarks on granting the "ship" a "pilot" to "steer [it] safely whither [it] listeth" [2001a; 262].

It is appropriate, therefore, that most of our contemporary vocabulary of risk descends from ancient maritime terminology (e.g. 'risk' itself may derive from Latinate terms for 'reef').

Rationality, thus, is "*periculum*": a nautical term simultaneously denoting 'turbulent hazard', 'high-returns venture', and 'obligating contract' [Huet, 2010; 3]. For one does not assume binding responsibility without undertaking meaningful risk; hence, why 'X-risk articulation' is here positioned as a major threshold of enlightenment. One must indeed "*dare to think*". Yet, when thinking becomes unmoored from *all* circumspect foundations, it is thought itself that, ultimately, comes to be at stake.

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As an accordingly consequential threshold in humanity's collective intellectual maturation (in our "emergence from self-imposed nonage", if you will) the emergence of sensitivity to X-risk, as historical event, elicits two questions: 1) 'why, exactly, was X-risk not cognized before the eighteenth century?' and 2) 'why, if this discovery is indeed so significant, has it not previously been flagged as such within intellectual history?'

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In depicting cognition as a vessel navigating stormy seas, Kant was granting metaphoric garb to his *epistemological anti-foundationalism*.⁸ This pinpoints his significant break with prior tradition and, moreover, provides the answer to the first of the questions posed above.

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Discovery entails prior ignorance. Extinction was cognitively unavailable for much of intellectual history. Why? This is directly due to the fact that—throughout ancient and medieval thinking—epistemic foundationalism was uninspected as the ‘only game in town’. Foundationalism is the assumption that ‘truth’ must be founded, somewhere, in *unmediated contact* between the order of representation and that of existence itself. There is, therefore, some putative point where the structures of ‘being’ and ‘thinking’ converge, seemingly providing a justifier that needs no further justification. This entails that naked existence must itself be ‘epistemically contentful’ (imbued with epistemic qualities and data) regardless of its relation to—or indeed the presence of—any epistemic agent. Or,

⁸ Kant is sometimes considered a ‘foundationalist’ because of his Theory of Categories. For Wilfrid Sellars, Kant was a champion of anti-foundationalism in rejecting what Sellars called the ‘Myth of the Given’. The Myth is the presumption that we can know things about non-epistemic nature without the mediation of epistemological norms that are not themselves immediately or straightforwardly parts of nature. Insofar as Kant’s Categories are epistemological fundamental, they can be called a foundation; but, insofar as he denies that they are natural or naturally-imposed, they are not *foundationalist* in the sense of ‘Given’. Kant, therefore, was an arch-enemy of arrogated immediacy and self-justifying foundations in knowledge—whether conceptualized as empirical sense-data or pre-established harmonies—yet it was his heir, Hegel, who took this to its conclusion by noting that Kant’s own much-vaunted Categories were not inviolable, but themselves mediated by historical and communal tribunals.

formulated differently, *if being and thinking are identical, then thinking cannot cease to be*. Such a stance goes straight back to the beginnings of Western philosophy.

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Western metaphysics begins with the Parmenidean declaration of foundationalism. We explore this later. For now, we note that Parmenides of Elea, in discovering the fundamental laws of thought, mistook them for laws of being *simpliciter*. The most important of these is the most basic: the ‘Principle of Identity’, expressed as ‘ $A=A$ ’. This has two consequences. First, ‘being’ must maximally ‘be’ (because ‘*being=being*’ and non-being is not); and, second, cognitive representation must, in some way, ‘be’ the being that it represents (because there is, bluntly, nothing else for it to be). The former leads to the venerable ‘Principle of Plenitude’, stating that, because being must be itself maximally, there are *no eternally unrealized possibilities* (a direct consequence of the foundationalist conviction that orders of justification and those of existence are identical, such that being can admit of no unjustifiable gaps or absences that ‘just are’ without justifiability); whilst the latter neatly leads into the Aristotelian model of demonstrative knowledge, which presumes that reality itself has a propositional or logical architecture, exhaustively compliant to syllogistic analysis (and, thus, if ‘being’ itself has an essentially rational composition, then rationality simply cannot itself cease to ‘be’). The former commitment obstructs sensitivity to extinction generically—whether human or non-human—by precluding the *irreversibility* requisite to conceptualize the extirpation of any species as being in any sense meaningful (i.e. it was long presumed that *should* any species be destroyed, it would merely later re-emerge); whilst, in addition, the latter commitment inhibits any notion of a specifically ‘*human extinction*’ in the stronger and more fundamental sense established above (i.e. ‘where being is itself rational, rationality

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cannot cease to be’). Correlatively, when Aeschylus [1947; 20-1] or Hesiod [2006; 103] wrote of Zeus’s plan to “destroy this race [of] human beings”, and when Plato rehearsed this epic episode in his *Protagoras* [2004; 19], we observe that it *cannot* be an ‘extinction scenario’ in the modern sense because it does not comprise an end of sapience. For, in the Platonic doctrine of the Idea, we again find the foundationalist conviction that reality is intelligible because it is essentially intellectual.

Nearly 1500 years later, Aquinas again encapsulates such sentiment, expatiating that “[e]ven if there were no human intellects, things could [still] be said to be true because of their relation to the divine intellect” [1952; i.11]. Therefore, it is *only after* a localization of epistemic and propositional contents to concept-mongering animals that intelligence first became infinitely precarious—and, thereby, infinitely precious—such that the concept of ‘extinction’ could finally accrue meaningfulness and, ultimately, its uniquely ‘astronomical’ significance. We delineate said ‘localization’, and its historical catalysts, across the coming chapters.

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There was thus a time before which people could *not* forecast existential threats, and a time after which they *could*. Why, then, has such a threshold gone largely unnoticed?

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In terms of lay consumption, the first conspicuously popular engagements with our prospective extermination emerge from the early nineteenth century efflorescence of ‘Last Man’ texts: extending from Byron’s 1816 ‘Darkness’ to 1826’s *The Last Man* by Mary Wollstonecraft Shelley (hereafter, ‘MWS’). These, of late, enjoy scholarly attention. However, notwithstanding the soon-to-be explored fact that naturalistic anticipations of human extinction appear as early as the early 1720s—thus

significantly pre-dating this literary fad—treatments of ‘Last Man’ texts have tended to obfuscate the very novelty of their subject matter.

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Critics within fields of cultural and literary history have been liable to elide the particularity of ‘extinction’, as conceptual category, by subsuming it under categories more venerable and/or familiar: thus occluding the specificity of its *emergence* at a certain time. Cultural commentators, in other words, consistently misclassify ‘extinction’ as merely the modern garb of a transhistorical and pancultural mythology of apocalypse, or, alternately, they explain it away as the author’s straightforwardly ampliative extrapolation of autobiographical traumas onto the human whole.

Exemplary of the former approach are statements from I.F. Clarke, who subsumes these first depictions of existential precarity under ‘a continuing mythology of doom’. They are, he writes, a mere renewal of the ‘immemorial fears’ of ‘archaic cosmogonies’ extending from ‘*Ragnarok*’ to ‘*Götterdämmerung*’: ‘quarried’, that is, from ‘the deeper levels of the psyche’ [1979; 43]. Though often less overtly perennialist, other critics invariably frame the matter as ‘mythopoeic’ (referring to the ‘last-of-the-race myth’ [Stafford, 1994]) or, alternately, they gloss it as a ‘secularized eschatology’ [Wagar, 1982; 13].⁹

Turning to the ‘biographical’ approach, the paradigm case is, of course, scholarship of MWS’s *The Last Man* which, even in its deconstructive phase, could not countenance extinction as the inconsolable termination of biography because of its commitment to the interminability of signification.¹⁰ Again and

⁹ Also cf. Alkon [1987; 190] and Paley [1991].

¹⁰ This route, however, is not unique to modern readings. Already, in a contemporary review of MWS’s *Last Man*, the terminality of extinction is sublated by linguistic means: wherein it is proclaimed

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again, the occasion for explorations of extinction is reduced (i.e. domesticated) to autobiographical tragedy: to Byron's 'expulsion from London society' [Sambrook, 1966; 29 & Vail, 1997; 189]; to Mary Shelley's loss of both Byron and Percy Bysshe Shelley (hereafter, 'PBS') [Stafford, 1994; 7-8]; to the psychodrama of 'mourning' or 'suicidal wish-fulfilment' [Vail, 1997; 189] and its attendant 'poetics of extrapolation' [Horn, 2014; 72].¹¹

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Yet human extinction is neither closet drama nor transhistorical mythoi: it is not extrapolated solely from lived experience nor is it available—prior to experience—as inherent archetype. The ecumenism of the 'secular apocalypse' approach fails as historical explanation insofar as it is actually ahistorical in its reliance upon perennial archetypes [cf. Halmi, 2007; 123]. And, likewise, if extinction is a simple matter of 'extrapolation' from locally ruinous experiences, why did it not occur to ill-fated individuals prior to the late eighteenth century? Both stances, that is, are incapable of acknowledging the historical 'event' of the idea's enunciation because they are ill-equipped to accommodate the unique philosophical attributes that individuate 'extinction' as a determinate concept in opposition to other concepts that might, trivially, appear similar (and, ergo, they are concomitantly unable to gain explanatory traction upon the notion's inception at one time rather than any other).

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that one cannot express 'lastness' in writing because "[t]here is no getting at the last of our never-ending, still-beginning language" [anon, 1826; 137].

¹¹ Explaining 'extinction' as 'ruins discourse' [e.g. Redford, 2012] confronts similar problems: *Ruinenlust* requires a projected observer; extinction constitutively forecloses such proleptic retrospect.

An upshot of Kant’s ‘Copernican Revolution’ was to fold cognition into insuperable self-relation.¹² The scope of such ‘self-relation’ has been interpreted in innumerable ways. One tradition (prevalent across the humanities) inherits it along generically ‘phenomenalist’ lines as the enclosure of legitimate knowledge to the domain of the qualitatively meaningful: leading, thereby, to an anti-realist stance that demotes intangible objects (such as those posited by theoretical science) to ‘myth-making’.¹³ Very broadly speaking, both of the major approaches to ‘literary extinction’ emerge from this cladistic lineage. Desirous, that is, of a connection to something qualitatively meaningful or intuitively tangible for us, they elide extinction into more domestic categories (i.e. ‘apocalypse’ or ‘trauma’) thus erasing the *labours of abstractive reason* that, in fact, mark the concept out as unique (individuating it as an achievement of what Sellars called the ‘scientific image of man-in-the-world’ in its constitutive opposition to the ‘manifest image’ of persons, intents, colours, smells, sounds, qualities, and inherent meaningfulness [1962]). Indeed, the very difference specific to human-extinction-as-concept (singling it out, that is, as a unique object for what Koselleck called ‘rational prognosis’ [2004; 19]) is that, in forecasting the *end* of phenomenality, it is constitutively *intangible* in phenomenal terms. (That is, we can attribute empirical determinations to the etiological lead-up and ‘kill-mechanism’ of our extinction, but intuiting the sensible qualities of a *post-mortem* world—as constitutively devoid of our ‘forms of intuition’—instantly becomes problematic. As we later explore, ‘extinction’ is concordantly

¹² Objective knowledge is *inseparable* from subjective conditions of knowledge such that knowing about the external world proceeds in step with self-reflections on our cognitive frame.

¹³ Continental philosophy, roughly speaking, interprets the ‘subject’ of Kant’s self-relation as the locus of the irreducible particularity or lived ipseity of a phenomenological and embodied ego (rather than the more Anglophone glossing of said ‘subject’ as the rule-bound and discursive cohesivity of a ‘unit of account’ within the ‘logical space of reasons’ and, thus, as a ‘rational player’ within the ‘game of deontic scorekeeping’ [Brandom, 1998]).

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a cardinal offshoot of ‘the scientific image’ in its ‘eliminative’ stance *apropos* our ‘manifest’ lifeworld.)¹⁴

Both ‘mythical’ and ‘autobiographical’ glosses of the extinction-topos obscure this provenance by attempting to collapse the notion back into terms compatible with the lifeworld of tangible and self-presenting phenomenal meaningfulness, thusly jeopardizing its unique expressive role as pronouncing the prospective termination of all meaning itself.

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In retracing these ‘labors of abstractive reason’, we hope to rehabilitate a strain of post-Enlightenment thought that is often occluded by scholarship’s championing of Romanticism’s allegiances to the qualitative and parochial: replacing its ‘topographies of the sacred’ [Rigby, 2004] with the disembedding estrangement of globalizing prospects; whilst counterposing the lionization of vitalistic and noetic ‘absolutes’ with the contemporaneous discovery that the universe is, by crushing majority, inorganic and sterile.

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And so, ‘extinction’ is not reached purely ampliatively through experiential data (the historical case of fossil evidences reiterates this); neither, however, is it given to us, prior to historical experience, like some inherent psychological archetype (the chronological determinability of its inception belies such a contention, as it was evidently ‘discovered’, and thus is not subsumable under transcultural and transhistorical typologies). It is thereby not reducible, in either direction, to the tangible facts of our

¹⁴ This latter is a core thesis of Brassier’s *Nihil Unbound* [2007]. This book exerted a significant influence on the current project; though I, like Brassier himself, now disagree with many of its conclusions.

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lifeworld—whether as ‘lived experience’ or as ‘shared mythoi’—because it is, through and through, involved with what is *counter-to-fact* and *non-qualitative*. It emerges, therefore, from our ability to reason, rigorously, from counterfactuals. For positing the termination of cogitation involves postulating items and events that are not merely unobserved (like mythic items: such as, say, a unicorn) but that are, in an altogether stronger and more technical sense, posited as unobservable as such (just like the ‘theoretical objects’ of science: from muons to gamma-rays). Counterfactual locutions of this latter type, in stark distinction to myths and legends, are *expressively self-aware* of the fact that they refer beyond *all* possible human observation (unlike our unlucky unicorn, who is postulated as ‘observable’ yet is merely, thus far, ‘unobserved’). In other words, such locutions (unlike myths) involve prior reflections upon observation’s limits. This is why, as is the core contention of this thesis, the intellectual discovery of ‘human extinction’ arrives as a collateral premise of Kant’s definition of rationality as self-legislation: because *overt* prognoses upon the future closure of human sapience are, *covertly*, also cardinal articulations of our sensitization to our own cognitive finitude. And so, this is why—in spite of contemporary traditions that inherit philosophy’s ‘Copernican Turn’ as collapsing ‘predictive science’ into ‘myth-making fabulation’—Kant’s philosophical revolution is in fact non-coincidentally cognate, in terms of intellectual history, with our first sensitization to existential risks.

§

This brings us, neatly, to comments on methodology. It is precisely the notion spelled out above (i.e. that any explicit description of human extinction necessarily involves implicit ‘critical-philosophical’ self-reflections) that governs the ‘dual-aspect’ nature of the thesis, mentioned above. ‘Extinction’ is, first, a form of *pragmatic legislation* upon epistemic finitude (i.e. realising the universe

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is not itself inherently noetic in structure), before it gains any *descriptive content* within the ground-level vocabularies of empirical and forecastive science (from geoscience to probabilism), yet it nonetheless requires the arrival of these latter vocabularies as sufficient condition for its eventual full explication. In other words, these two layers of exposition (‘descriptive-empirical’ & ‘pragmatic-philosophical’), though in some sense distinguishable, are, in another sense, totally inseparable. ‘Extinction’ is, accordingly, a discovery that is not fully empirical because it involves reflection upon the lawful, rather than merely sensorial, limits of the empirical; and thus, as needs be, it cannot be empirically articulated, as it is only expressed counterfactually and modally; but it is, notwithstanding, a proposition of cognitive self-legislation only reached through intimate negotiations with the messy contingency of empirical and historical experience: ranging from encounters with historical upheaval to ensuing socio-political disenchantment.¹⁵ As the contemporary philosopher of science, William Whewell [1858], realised: ‘intellectual discovery’ indexes the self-propelling intertwinement of careful empirical-level observations of the natural world with in-step elaborations of salient features and limitations of our non-empirical (i.e. semantic) frame upon said world. The one advances the other, in positive feedback-loop. Thus, our history of the discovery of X-risk is characterized, on the one hand, by a sense of the stadal and inevitable unfolding of a logical self-explication thusly rarefied from the vicissitudes of experience; whilst, on the other hand, it is also coloured, through and through, by the particularities of material history and its unforeseen contingencies. This, simply, is product of taking

¹⁵ It could be objected that empiricists concern themselves with the limits of the empirical. This may be so, but ‘extinction’ concerns limits that are *lawful*—or counterfactual supporting and intensionally defined—in a way that empiricists, as embodied by Hume’s suspicion towards subjunctive expressions, cannot countenance. ‘Extinction’ presupposes what we later call ‘robust finitude’, rather than the empiricist’s ‘shallow finitude’.

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seriously the Kantian lesson upon the fundamental togetherness of ‘sensation’ and ‘understanding’, or, the co-dependency of empirical descriptions and rational explanations.

This, also, is why the project is rooted in the eighteenth century yet, stereoscopically, compacts a much deeper retrospect. Philosophy, in its ‘framework-explicating’ role, bequeaths breakthroughs of a semantic nature that then become embedded in discursive practices and vocabularies such that one can wield them without having any understanding of *where* they came from or *why* they were once ‘breakthroughs’ (much like our everyday usage of technological devices whose inner-mechanism we are utterly ignorant of). A prime example is the fact most educated people now have perfectly workable grasp of the locution ‘*possible world*’, even if they have never touched Leibniz or Lewis. Thus, to invoke the prime example of Byron’s ‘Darkness’: the author could be entirely contemptuous of philosophy, as indeed Byron was, whilst nonetheless being thoroughgoingly ‘philosophical’ in everything written therein. Speaking broadly, language is a vastly distributed model of the world and we all benefit from updates in its functionality without necessarily understanding the ‘how’ or ‘why’ of the update.

§

The project is necessarily interdisciplinary. Partly because disciplinary boundaries largely postdate our historical range; partly because of the fact our topic evidently emerges as a confluence of multiple technical lexicons across various domains; but also because of our resulting approach to texts. I treat relevant texts, that is, predominantly under their guise as ‘miniature worlds’ (which was itself contemporaneously a popular notion, given Baumgarten’s theorisation, in his 1750 *Aesthetika*, of fictions as “*heterocosms*” [Abrams, 1971; 272-85 & Stapleford, 2012]). This comes from the relevance of counterfactual reasoning indicated above. For it is only in the subjunctive mood that our extinction is

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articulated and (long before established terminologies and protocols of long-term forecast and futurology were consolidated and institutionalized) ‘literary worlds’ thereby provided the sole arena for exerted experimentation upon propositions of such a hypothetical nature.

Accordingly, I treat texts, primarily, as ‘chronotopes’ in order to foreground the ways they were utilised *as models for thought-experimenting* (or, as we later explore, ‘model-based reasonings’). We inherit the term ‘chronotope’ from Bakhtin [1981]—who borrowed it, suitably, from his Russian peers in proto-cybernetic fields of biosemiotics and earth systems science [Petrilli & Ponzio, 2005; 149]—where it refers to the operation of a text whereby, in close collaboration with the reader, it simulates its own sense of a self-sufficient spatiotemporal whole, or, ‘world’. It does this by enacting, fabricating, or insinuating tacit constraints of coherence and regularity across diegetic time, space, causal implication, and natural uniformity (that, if not explicate at the level of narrative contents, nonetheless inform all diegetic events as their implicit and governing frame). Hayot, indeed, dubs this the ‘work’s preconscious’ [2012; 26]. In highlighting the text, in this way, as its own globally-cohering surrogate ‘world’—insofar as it, by consequence, rehearses all the relevant regulative constraints and explanatory norms that we appeal to *vis-à-vis* our own ‘world’—we can concordantly comprehend how fictional narratives offer themselves readily as vessels for productive thought-experimenting. Or, whether an acknowledged intent or not, it is the case that to depict anything consistently within a chronotope assuming the relevant constraints of coherence is implicitly also to proffer its minimal plausibility. We see texts as laboratories, therefore: such that, rather than science being an appendage of literary myth-making, ‘poetic worlds’ are, instead, themselves an instantiation of the kind of ‘abductive reasoning’ that characterizes the motor of scientific theory-

generation. And so, combining this also with Hans Blumenberg’s practice of ‘*metaphorology*’ [2010]—as the historical study of metaphors insofar as they provide the sedimented repository of the formation and consolidation of philosophic paradigms—we aim to approach early fictions on X-risk through this methodological lens (i.e. encountering them as ‘world-models’ and, concordantly, as petrifications of obsolesced *Weltanschauungen*) in order to help excavate their motivating and informing intellectual contexts (and, thus, further triangulate the emergence of X-risk sensitivity).

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In conclusion, some remarks on structure are in order, by way of a clarification of terminological taxonomy. ‘Extinction’, that is, can be disaggregated into the following nested conceptual hierarchy, leading up to ‘full-scale’ human extinction:

- 1) Terminus of a biological species, human or non-human.
- 2) Terminus of *Homo sapiens* as biological species.
- 3) Terminus of sapience, and all rational activities, as supervenient upon humanity as species-specific substratum.¹⁶

Only the final level indexes ‘human extinction’ in the *full sense* pursued by this thesis; yet the preceding notions are necessarily nested within it and implied by it. When we refer, throughout the following, to ‘extinction’ we refer, unless otherwise qualified, to this third sense (‘species extinction’, for example, is employed to refer exclusively to the first sense). We add that each level, in turn, is specifiable by relevant variables as to whether the termination is ‘simultaneous’/‘granular’, is ‘anthropogenic’/‘non-

¹⁶ Humanity is clearly not the only *intelligent* animal, but, thus far, is the only *rational* one.

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anthropogenic’, and whether it is tensed ‘past’/‘ongoing’/‘future’ (for example, the wider public first found the cluster ‘ongoing’+‘anthropogenic’ more readily palatable *apropos* nonhuman extinctions). ‘Human extinction’ scenarios, in the full third sense, are further predicated by notable variables of ‘coevality’/‘non-coevality’ (i.e. whether humanity’s destruction is coincident with that of the wider biosphere) and of whether their conceptualisation is ‘scientific’ or ‘speculative’ (i.e. whether the event is received in a deflationary and critical manner, or, is attributed some kind of metaphysically-inflated cosmological or mystical significance).

Finally, each of the three echelons listed above demands unique expressive conditions. These are:

- 1’) Appreciation of irreversibility in nature.
- 2’) Removal of the chauvinist bias by which humanity, within an otherwise static nature, alone has requisite agential leverage to kill entire species. Or, if we aren’t the only ‘murderer’, we can ourselves be ‘murdered’.
- 3’) Comprehensive localization of conceptual content to human minds.

Though interdependent, each echelon roughly corresponds to a chapter. After Chap.1’s delineation of major thematic motifs, Chap.2 explores echelon ‘1’ in relation to the discovery of ‘terminality’ in nature, Chap.3 then expands on ‘2’ in dialogue with eighteenth century geoscience, whilst Chap.4 recounts the long-range philosophical genealogy of echelon ‘3’. To conclude, Chap.5 explores the aforementioned fork between ‘scientific’ and ‘speculative’ receptions of human extinction.

‘FROM THINE INORGANIC VOICE’: the PHYSICS of the UNCONSCIOUS

And the so-called All-Life with which Pan was endowed was [supposed to include] the gigantic encirclement of a primal past, prevital as well as postmortal, in which there is no place for individual life.

—Ernst Bloch

0—INTRODUCTION: ANNUS TERRIBILIS

Something was in the air in 1816. It was a 100-megaton sulphate aerosol layer. Girdling the planet, it was formed from ejecta from Mount Tambora’s eruption of the previous year. Lending itself to incarnadine skies and glowering sunsets, we can retrospectively measure the sheer scale of this meteorological event from chromatic analysis of contemporaneous landscape paintings, tracing a world-asphyxiating dust-cloud [Zerefos, 2007]. Tambora’s inferno in Dutch Indonesia—the largest eruption since civilization emerged during the Holocene—pumped mammoth amounts of debris and CO₂ into the stratosphere, provoking global fallout: unleashing utterly tempestuous weather across the Northern hemisphere, there was widescale collapse of harvests, with yields plummeting by >75% during 1816-7, cascading into turbulent price fluctuations, economic recession, ensuing riots and geopolitical instability. 1810-19 was the coldest decade for over 500 years, representing the ‘most catastrophic sustained weather crisis of the millennium’ [Wood, 2014; 41]. Snowballing into Europe’s last continent-wide subsistence crisis, rural mortality rates were severe. Tragedy in the West was matched in the East by one of the most devastating famines in Chinese memory. Heavy precipitation throughout the Bay of Bengal—altering microbial ecology—triggered a deadly new cholera strain, ploughing its way through human digestive tracts across the world, eventually murdering *tens of millions* as it divaricated across

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continents, cycling smallest and largest scales. Tambora's planet-enclosing causal cascades were reconstructed only *post hoc* in our own time; contemporaneous denizens lacked the conceptual apparatuses required to forensically capture its complex local-global loopings; yet, following the prior century's historical entrance of political universalism, human cognition was concurrently becoming gripped by a similarly global-scale idea, one of similarly universalizing enclosure.

Human reasoning, that is, was becoming grasped by realization of its own existential precarity. Sanguine skies did not provide the backdrop for sanguine thoughts, unsurprisingly; for there was something else, a novel conceptual strain, in the air; it was thought of human extinction, or, existential risk. For, just as local storms were downstream of truly non-local climate systems, so too were embodied human minds—in spite of all the particularities of their lived present—first becoming 'feedforward conversant' with the similarly globalizing prospect of their future extinction: a kind of terminal horizon, that, in turn, irreversibly changes what it means to *think* and *act* in said present. For, insofar as it is constitutively absolute in scope, 'human extinction' denotes an enunciation revealingly symmetrical to that of 'the universal': and, just like the first historical articulation of the universal, it, too, triggers tangible real-world ramifications; not just happening *within* reasoning, it forever changes what it means *to reason*.

Zoom in on Villa Diodati, Lake Geneva, Switzerland: the 'Satanic School' of vanguard intellectual voices—comprised of Lord Bryon, PBS, and MWS—provides a mouthpiece for this development, becoming the point of contact for extinction's debut within popular cultural self-understanding. In the present chapter, we occupy this intellectual 'ground zero' to demarcate the thesis's major themes.

June, 1816: titanic thunderstorms keep the party indoors. Here they discuss humanity’s longest-term prospects. As established below, we have firm evidence that the group had become occupied with such speculations. Journalist Cyrus Redding (himself entangled in the literary Last Man’s contested provenance) later relayed a rumoured conversation from Diodati:

Byron and Shelley [were] standing together, in a day of brilliant sunshine, looking upon the Lake of Geneva. Shelley said, ‘What a change it would be if the sun were to be extinguished at this moment; how the race of man would perish [...] How terrible would be [this] fate!’

[Redding, 1860; 304-8]

Suitably, each writer’s next major work directly engages extinction. Most proximally, Byron’s 1816 ‘Darkness’ extrapolates global refrigeration. MWS’s 1818 *Frankenstein* invokes extinction as the hypothesized consequence of the monster’s establishment of a competing ‘species-being’. We explore these later. PBS’s *Prometheus Unbound* of 1820 (hereafter, *PU*), the focal point of the current chapter—whilst not diegetically depicting extirpation—includes it as a major subjunctive threat.

Just as global climate cannot be reduced to local weather-pattern, extinction’s entrance into human self-conception cannot be reduced to the occasional catalysts of volcanic thunderstorms and doomy feelings abroad during 1816: neither intuited nor innate, the universal-scope of the idea makes its emergence complicated. The problem parallels Weber’s delineation of the paradox of universalism’s entrance into history at a specific geographic locality and chronologic moment [2002; 356]. *How does ‘somewhere’ & ‘somewhen’ become first possessed by ‘nowhere’ & ‘nowhen’?* The answer lies in reason’s discovery of its autonomy from *any* locale or parochial horizon—which is indistinguishable from its expatriation from *any* conceivable dwelling or belonging—and it expresses this disembarking from secure foundations not only as its categorial imperative of practical universalizability but, conterminously, through the cognate realization of an existential precarity of identical scope. To get a

preliminary grasp on this, we here undertake a study of the functionality of *globes* within PBS's poetic microcosms, as a way of reconstructing important torsions and shifts in contemporary understandings of rationality's 'belonging'—or lack thereof—within the widest universe. Along the way, we establish *the discovery of the inorganic*: the intellectual and scientific event that marks first conception of a 'death' (or, more precisely, a vast abiotic natural domain) that is unrelated to any life and undetermined by the living as such. This is key to what will follow.

1—UMBILICAL PHYSICS

The sphere has been master-metaphor of the metaphysical ever since the Eleatic inception of the latter. From its very beginning, philosophy proclaimed being to be a "*eukýlou sphaíres*" ("well-rounded ball") [Parmenides, 2009; 78]. This is because spherical geometry, uniform in all directions from centre to circumference and rotationally invariant (i.e. identical under arbitrary rotations), encodes *exhaustive containment*. This is why the sphere offers itself as the default spatial format of metaphysical idealism: insofar as exhaustive containment indicates an elimination of true exclusion, indivisibility, and heterogeneity (for, as with explicans and explicandum, if the 'container' *excludes* qualities of 'the contained', then exhaustive inclusion and explanation cannot be achieved), and, thus, spherical containers perfectly code for the epistemologically foundationalist commitments inherent to such idealist systems; or, sapience is understood to be perfectly 'contained' because the universe that 'contains' it is itself inherently sapient. Metaphysical idealism avers that there is no such thing as a 'dissimilar medium': *containment goes all the way down*. Its founding Principle of Identity—in its tautological reduplication of ' $A=A$ '—renders this interminable immersion within book-ended being, as reason relates synecdochally to the cosmic whole which in turn includes reason essentially, securely,

and necessarily. Tautology is containment. This ancient idea is recapitulated by Wordsworth’s claim that humans are “Dwellers of their Dwelling” [‘Home at Grasmere’, ll.647-8].

Such ‘amniotic’ inclusion of thinking within being remained the fundamental metaphoric function of spheres until the eighteenth century. However, Peter Sloterdijk diagnoses this period as ‘twilight of the orb epoch’: noting it as harbinger of the ‘collapse of the metaphysical immune system’ [2014; 43-5, 559] that was once proffered by these geometric ‘inclusion figure[s]’ [2011; 329]. Globes, that is, no longer necessarily communicated irreducible inclusion of ‘dwellers’ within ‘the dwelling’. They could, indeed, now express the opposite.

In his first *Kritik*, Kant wrote that, although the earth appears to one’s senses as merely a “flat surface”, we can, in “accordance with principles *a priori*”, know it is a “sphere” with “circuit, magnitude and limits”. Paragraphs later, he adds that human “reason” is likewise “not like a plane indefinitely far extended” but “must rather be compared to a sphere”. The comparison serves to capture critical rationalism’s core injunction that, though the cascading content of sensation is potentially infinite (in the sense that traversing a sphere’s continuous surface provides no boundary), the ‘space of reasons’ governing it (i.e. the discursive rules and functional norms regulating sense experience) nonetheless generates bounds or “limits” (just like the spatially-finite, three-dimensional ball) [CPR; A759-62/B787-90].¹ Kant’s ‘sphere’ metaphor, therefore, here serves not to ground reason’s warrants (for thinking things as thus and so) within brute existence through some including-and-inclusive foundation (whether it be sense-data or innate ideas); but instead expresses the reliance of such

¹ Topologically speaking, the ‘figure of the earth’ can be represented as a ‘manifold’ that has ‘no boundary’ yet is ‘finite’.

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warrants on values of holism and coherence that are spontaneous—and exclusive—to discursive consciousness itself. This encodes Kant’s insistence on the autonomy of the rational. Here, then, the sphere serves a new and distinct expressive purpose: not to reiterate the submission of cognition, *holus-bolus*, to the tyranny of some foundational existence, whether metaphysic or sensorial; but, instead, to consummate that aspect of cognition whereby it can become self-governing and, thus, can legislate its contents relative to a *global criterion of correctness* that supersedes and opposes the merely parochial and exigent authorities of sense-data, received doxa, or common-sense intuitions. Yet, in precise concomitance with its expatriation from such ontic foundations, human reason reneges the specifically ontic insurance, enclosure, and protection that they once provided: as is the core contention of this thesis, ‘responsibility entails risk’, such that the exact corollary of rationality’s inauguration of its own self-governance is its simultaneous sensitization to its utter precarity (and, therefore, extinction).

Notwithstanding this, Kant noted of his comparison (between discursive and planetary spheres) that we are “ignorant with regard to the objects which are contained in that surface” [CPR; A759/B787]. Exploiting this sentiment, Schopenhauer later wrote that “[c]onsciousness is the mere surface of our mind, and of this, as of the globe, we do not know the interior, but only the crust” [1969; ii.136]. As we shall see through the following, this post-Kantian insistence on some chthonous irrationalism encrypted an attempted backdoor repatriation of rationality within non-conceptual nature by way of ‘depth psychology’: constituting Romantic idealism’s attempt to respond to new-found realization of human precarity within nature without committing itself to the full severity—and thus responsibility—that is invoked thereby.

PBS's *Prometheus Unbound* unfurls within truly global prospects. The play's chronotope is strictly correspondent with the planetary: the *orbis terrarium* itself operates as the work's sensorium. PBS (whose 'poetic space is vast, covering East, West, North, and South' [Alvey, 2009; 7]) focalizes his 'on-stage' drama to the Indian Caucasus, yet this diegesis is incessantly mediated by planetary prospects: by the "struggling World" [*PU*, I.577], by the "brotherhood [of] Earth" [II.iii.93-4]. Indeed, Earth itself is a primary character. Yet, the chronotope doesn't just encompass the planetary surface, it also enacts an axis of planetary depth. We move below the merely geodesic and into the hypogaeal: dropping through "fire-crag[s]" [IV.333] and "[t]hrough the caverns hollow" [II.i.197],

To the rents and gulphs and chasms
Where the Earth reposed from spasms

[II.i.201-2]

Telescoping from "clouds" and "winds"—drilling "[t]hrough tangled roots and trodden clay"—to underlying "granite mass" [IV.370-3], whilst finally subducting down to "adamantine central gloom" [III.iii.86], the poem's 'Earth' is unmistakably an internally variegated and foliated mass, with its own dynamics and inner-constitution, all on full display: a cross-section framed within by "crag-built deserts of the barren deep" [III.iii.122] and the "caverns [of] hollow mountains" [IV.332]. Indeed, as we soon explore, this inorganic world was contemporaneously first being dissected, its immeasurable spatiotemporal precedence being laid bare.

Around 1805, Cuvier pondered upon the fact that "[o]nly about 1/1,600 of the diameter of the earth has as yet been penetrated" [2008; 85]. Following this realization, Schopenhauer decreed that predicating the "planetary system" as "organism" is "absolutely inadmissible" [1969; ii.296-7]; the biosphere, he noted, is merely a "mouldy film" on the surface [1969; ii.3]. Being able to articulate this,

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however, was historically novel. This is of vital importance to the story of X-risk awareness because it demonstrates a necessary cultural-philosophical migration from presumption of the infinite mutual-inclusivity of mind and nature (and the concomitant expulsion of death from ontology) towards a more mature acceptance of ‘depth’ (both extra-terrestrial and subterranean) as an excluding medium of inorganic sterility. We trace this migration through the ‘physics’ of PBS’s poetic world-models, delineating a shift from feting our security within the “immense concave” [*DotW*, ll.143] of “Nature’s utmost sphere” [‘To Constantia’, ll.3], toward instead envisioning “earthquakes cracking from the centre up / And splitting the great globe like brittle ice” [2010; iii.13-4].

From the macrocosm’s “ebon vault” [*QM*, IV.4], through the “million worlds which burn and roll” [*PU*, I.163], to the molar scale of “life’s sphere” [‘Athanasē’, ll.55] and its “folded powers” [*L&C*, ll.675], down into the microcosmic “sunlight of the spherèd dew” [*PU*, II.iii.87], Shelley’s model of the cosmos arises as dizzying series of staggered interiorities: each horizon comprehended by another, *ad infinitum*. (Hemispheric enclosure, indeed, provides the vehicle of his ‘most famous simile’ in ‘Adonaïs’ [Cameron, 1974; 499].) Ever since being ‘spellbound’ by orreries at Eton [Marples, 1967; 157], PBS’s writing is laced with domes, globes, concavities and convexities: in his hands, nature becomes serially nested interiors, stacked concentrically. Recapitulating Augustine and *Liber XXIV philosophorum*, he exhorted that “each [life] is at once the centre and circumference”: the “internal nature of each being is surrounded by a circle”; a “circumference” that “animates [our] frame” [2002; 507]. Such comparisons

had been widely popular throughout Europe, present within French and British physiology as well as German *Naturphilosophie*.²

Appearing first in an 1811 letter [1964; i.201]—developing into the 1812 poem ‘To a balloon, laden with Knowledge’—and recurring incessantly throughout later works [*PU*, II.ii.69-82], PBS continually envisioned human minds, likewise, as “bubbles”. Within this schema, ‘*aletheia*’ or ‘truth’ becomes essentially diastolic: in knowing well, one becomes “dilated” beyond one’s “limbs” and the “mind [grows] like that it contemplated” [‘Mazenghi’, ll.143-4]. This process “distends” and eventually “bursts” one’s cognitive “circumference” [2002; 515]. Accordingly, PBS often pondered how it is that such fragile “bubbles” as human minds could “measure in their circumscribed domain the distances of [the cosmos]” [1964; i.201].³ Such ‘diastolic enlightenment’ is imagined reaching the very “casement” of the universe: the “dark dome” of existence’s utmost extremity [2004; iii.49-53]. For, engaging a tradition spanning from Plato to Seneca and Milton to Volney [Poole, 2008], 1813’s *Queen Mab* (hereafter, *QM*) envisions reason distending beyond the terrestrial “balloon” and, eventually, swelling

² Similar phraseology can be found in writing of PBS’s doctor, William Lawrence [1816; 139], as well as PBS’s philosophical touchstone, Drummond’s *Academical Questions* [1805; 248]. Both describe life as a “circulation” of afferent and efferent forces. This derives, ultimately, from Haller’s earlier redefinition of ‘organism’ as spatially-bounded circulation of assimilation and expulsion (subsequently developed by Bichat in France). Over in Germany, Schelling [1994a; 88] imagined mind as systolic contraction within nature’s universal centrifuge; Oken [1847; 29] declared “[a]ngular forms are imperfect, [and] organic [ones] spherical”; Tiedemann [1834; i.17], similarly, stressed that “[a]ll organic bodies [betray] a form more or less round”. Models of organism became strikingly stratal, comprised of intramural spheres: C.A.F. Kluge’s “somasphere”, “zoosphere”, and “neurosphere”; C.W. Hufeland’s “vegetative sphere” and “animal sphere”; C.G. Carus’s “dermatoskeleton”, “splanchnoskeleton”, and “neuroskeleton”, all nested sequentially. Coleridge (elsewhere defining life as “Esocentrism” [1995; ii.1204-5]) relayed such *naturphilosophisch* imagery in his *Biographia Literaria* [1983; i.286], attentively read by PBS.

³ Schelling referred to a similar process of “*Ausdehnung*”. PBS’s sources likely derive from Reid [1785; 730] or Young [1749; 170]: both described ‘sublimity’ as a cognitive explosion.

—from thine inorganic voice—

to encompass the *primum mobile* itself. Gazing inward from this utmost concavity, one witnesses an “interminable wilderness” of “involved immensity” [I.265-6]. Everything is “involving and involved” [PU, IV.241]: redefining existence as the telescoping concentricity of “infinite orbs” [QM, VI.146]. ‘*To be*’ is ‘*to be included*’.

Leibniz, almost a century earlier, secured his conviction that “nature is a plenum” [2014; 271] from, *inter alia*, his ‘Principle of Continuity’ (PoC). Inspired by his successes with infinitesimals and differential calculus, the PoC states that, between any two natural instances, there is necessarily an infinity of intermediary instances. Ergo, no interstice, no saltation, no genuine abruption. To be is to be included and to include in turn—*ad infinitum*. “Therefore”, Leibniz reasons, “there is nothing fallow, nothing sterile, nothing dead in the universe” [1991; 26]; conversely, “not only is there life everywhere [but] there are also infinite degrees of it” [2014; 272]. Put differently, because Leibniz ascribed infinite divisibility to matter, he attributed to it the “*synecheia*” (somatic self-similarity) that Aristotle first noted of organic bodies. Thus, for Leibniz, nature is interminably embodied. Or, each single life is contained within infinitely many other lives and includes infinitely many others in turn—*without remainder*—because, by the same token, there is simply no externality or death within which life could be excluded. No matter where one ‘carves’, no matter at what scale, one only derives further living instances—producing only smaller, quotient lives—and never arrives at the partition between ‘*life*’ and an indivisible ‘*non-life*’ that cannot be further accounted for. The expulsion of ‘unaccountability’ is key here, because this ontological organicism is precisely downstream from Leibniz’s metaphysical idealism: or, for Leibniz, the fact that ‘*to be*’=‘*to be alive*’ is merely an entailment of his higher-order conviction that ‘*existence*’=‘*judiciality*’. Continuity is direct entailment of this identity: the latter

(identifying ‘being’ with ‘juridical account’) is buttressed by the former ensuring existence is infinitely divisible into continuous accountability. Indeed, Leibniz’s ascription of ontic pleroma couples with its cousins in domains of modality to enforce just such an idealistic equivalency. These cousins are, firstly, the Principle of Plenitude (PoP) which states that ‘*no genuine possibility remains unrealised*’ (thusly ensuring that there are no *unjustifiable absences* within existence; or, there are no things that could have been—but simply just are not—without any further explanations). And, secondly, the Principle of Sufficient Reason (PSR): which is just the logical contraposition of the PoP (i.e. all present things have a reason because there are no absences of justification). Thus, to be is to be justified; existence *just is* its jurisprudential justification. Conglomerated, these principles interlock to strictly define nature as *nothing but* the bodying forth of an infinitely uninterrupted ligature and connective tissue of judicial reason. This is strict idealism because it hypostatizes methodological and regulative principles of mental inquiry as metaphysical laws of existence-in-and-of-itself; or, nature is nothing beyond an exhaustive embodiment of mentation, such that mentality itself cannot cease to exist. Within this schematic, ‘species extinction’ and, *a maiore ad minus*, ‘human extinction’ are comprehensively barred; there can be no absence of justification, just as, *a fortiori*, there can be no absence of life and/or value. Jurisprudent reason ‘*belongs*’ eternally: not just because the cosmos is infinitely alive, but because it is, moreover, infinitely prudential.

Spurred by Leeuwenhoek’s microscopy, Leibniz accordingly avowed “there is a whole world of creatures [even] in the least piece of matter”: each particle, *ad infinitum*, “can be conceived as a garden of plants and a pond full of fish” [2014; 132-3]. PBS rehearses an identical ‘fractal vitalism’ within QM,

—from thine inorganic voice—

declaring that each material quantum (even the “smallest particle”) contains “living things” and is thus itself “an unbounded world” composed of “infinite orbs” [II.226-34]:

I tell thee that those viewless beings,
Whose mansion is the smallest particle
[...]
Think feel, and live like man;

[II.230-4]

The poem’s chronotopic physics caches out as a *mise-en-abîme* of nested vitalities, committing PBS to a Leibnizian biologisation of infinity:

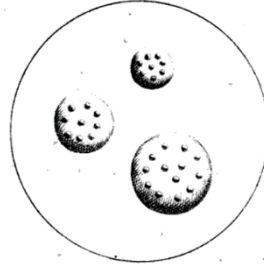
infinity within,
Infinity without,

[VII.21-2]

Though there is ‘no record’ of PBS reading Leibniz directly [Hogle,1988;349], this matters little: such preconceptions enjoyed ubiquity amongst PBS’s sources, from Euler and Laplace to Paine [2000; 304] and Drummond [1805; 68].

Inspiration may specifically derive from PBS’s 1812 reading of Lazzaro Spallanzari’s *Tracts*, which reports Spallanzari’s inspection of an animalcule or microorganism, the “volvox”, whose internal structure is described as uncannily resembling Ptolemy’s cosmology of “concentric” spheres: each carefully dissected stratum of which is found—from “circumference” to centre—to be further populated by multitudes of smaller, involuted “volvoes”. From this, the Italian physiologist derives support for the “successive envelopment of animals in animals”, declaring that the “volvox affords a new argument for inclusion” [1799; 52]. PBS merely inflates this volvox-principle to the fundament of

QM, translating Harvey’s *omni ab ovo* argument into metaphysical injunction.⁴ Indeed, the PoC, expressed temporally, is precisely this idea of preformationism [Leibniz, 2014; 273]: which essentially means there is no ‘*outside*’ of life.



Spallanzari's "volvoles" [1799; 68-9]

By this, the inorganic is effectively eliminated. “All things are recreated” [QM, VIII.107], whereby “decay” is sublimated as merely “[t]he monstrous nurse of loveliness” [2010; i.509].

There's not one atom of yon earth
But once was living man;

[QM, II.211-2]

The entire planet becomes determined by an uninterrupted palimpsestic domesticity, for “Thou canst not find one spot / Whereon no city stood”. Similarly, the prominent naturalist Erasmus Darwin proclaimed that

Awhile extinct the organic matter lies;
The wrecks of Death are but a change of forms;

[1803; 151]

Inheriting the same prejudices that motivated Leibniz, ‘death’ is only admitted in homeopathic amounts: as merely the asthenic transition between separate lives; as an artefact of limited perspective;

⁴ PBS: “[A]ll nature is animated, [and] microscopic vision [has] discovered to us millions of animated beings whose pursuits and passion are as eagerly followed as our own, so might [we] find that *Nature itself [is] but a mass of organized animation*” [1964; i.192-3].

as merely a dormant species of vitality; or, as regional deviations from the global default of organicity. This is of key importance, because it is a theoretical paradigm that essentially blinds us to acknowledging (and even observing) the *autonomous existence* of inorganic or abiotic domains, meaning we can't conceptualize a 'death' unrelated to any living instance (and, accordingly, nothing resembling the extinction of all life). Such presumptions were present even within early geological theories: notably, James Hutton & John Playfair's 'geocosmic organicism'.

Deeply agnostic regarding a period "prior to all organised matter", Playfair instead chose to insist, contrarily, that no "particle of calcareous matter" has not been "part of an animal body" [2011; 171, 154]. In decreeing perfect identity of past causes and present ones, Hutton & Playfair's 'uniformitarianism' was (when inflated—as indeed it was—into a metaphysical assertion rather than regulative ideal) nothing but a strong conjugation of plenitude: for the uniformitarian, 'the actual' *absolutely exhausts* 'the possible'. Nothing ever gained; nothing ever lost. By the time of writing his *Principles of Geology* in the 1830s, arch-uniformitarian Charles Lyell could not but accept fossils as the facsimiles of entire genera no longer extant, but he could only accept this by entirely sublimating the irreversible reality of said organism's extirpation. Convinced, that is, that we must consider all disappearances within nature as "merely local" (i.e. reconciled by their inevitable return) Lyell infamously exhorted that, given the correct "conditions", those "genera of animals" which are currently "preserved [in] ancient rocks" will inexorably "return": "[t]he huge iguanodon might reappear in the woods, and the ichthyosaur in the sea, while the pterodactyl might flit again through the umbrageous groves of tree-ferns" [2009; i.123]. In uniformitarian hands, extinction is therefore a mere "interval of quiescence" [Lyell, 2009; i.164-5].

In 1831, Coleridge decreed that, *toto genere*, all “Matter [is] the product of life” [CN; iv.5247&n], even positing a “conjectural origin [of Earth] in the mighty power of Life” [CN; v.6598]. This ‘conjecture’—extrapolated from reports of “new raised Coral Islands” [CN; iv.4845]—based itself in contemporary publications regarding the *biogenic origination* of materials such as charcoal [Macculloch, 1825]. Darwin himself, a major source for PBS, had endorsed full-blown ‘geozoism’: theorising a primordial and biotic “nucleus of the earth” (composed of minute “animals”).⁵ In “long series of time”, these microorganisms sequentially excreted and deposited the “solid strata” forming our lithosphere, procedurally ‘germinating’ the solid planet [2017; i.187].⁶ *Earth itself becomes a volvox.* (Significantly, palaeontologist Gideon Mantell later quoted *Queen Mab* as a key metaphor in his own exposition of geozoic theory [1838; ii.517]: citing PBS’s claim that even the “moveless pillar of a mountain’s weight / Is active, living spirit” [IV.142-3].)

By way of this cluster of commitments—and primarily by way of PoP’s enforcement of modal homeostasis through idealistically asserting the identity of ‘justifiability’ and ‘existence’—there is no ‘loss’ not reciprocally determined by its ‘consolation’ and, thus, all ‘death’ is essentially determined by the future ‘life’ it will inevitably pupate into. As already established, the exhaustive identification of ‘being’ and ‘biology’ attendant upon this is merely a downstream by-product of a higher-order idealist identification of ‘being’ and ‘jurisprudence’: for, mingling the *fact* of existence with the *value* of justice, the whole of being must be rationally justifiable and, ergo, valuable; and so, where life is inevitably

⁵ PBS encountered similar notions whilst reading James Parkinson [1811; i.9].

⁶ The Humean philosopher Thomas Brown contradicted this, defending the autonomous “existence of an inanimate part of the world”—arguing the “parts accreted, existing before their junction with the animal, must have formed a portion of the original matter of the world”—and, thus, were not generated “by the animal” [1798; 432-4].

deemed more valuable than death, the cosmos must needs be maximally alive.⁷ Neither mind nor life can perish: an assumption captured perfectly in PBS's infinitely oviparous volvox-ontology.

However, from the mid-1810s, PBS's poetic physics shift from sphereology to seismology: tracking with his discovery of a 'depth' recalcitrant to umbilical inclusion and thus also, by extension, the introduction of a death unamenable to any placental idealism.

2—A BRIEF HISTORY OF DEPTH

Where alien planets were assumed, by way of plenitude, to house rational life by default [Crowe, 1986; 18-19], the seventeenth century's Copernican revolution was not straight away the crippling humiliation Freud wanted it to be [1963a; 284-5]: easily retrofitted with infinitude, plenitude's exhaustive equation of universal possibility with local actuality amounted to extending anthropic life throughout deepest space, thusly populating infinity [Halmi, 2007; 42].⁸ As it happened, life had first to be regionalized *on our own planet* before we realized its regionality throughout outer-space.⁹ The first articulations of terrestrial organism's spatiotemporal locality—and, ergo, modal precarity—arrived conterminously with the eighteenth century discovery of geological depth, having revealed earth's

⁷ As will become increasingly apparent, epistemic foundationalism is 'of a piece' with the *naturalistic fallacy* [Sellars, 1997; 19]: in attempting to derive what are, ultimately, irreducibly normative warrants (for why we *should* or *must* think thusly) from naked existence one imbues existence itself with a normative architecture (such that, therefore, sapient norms can never 'go extinct'). Hence, the metaphysical extravagances and theodical preoccupations of the Leibnizian worldview. The corrective to this is to acknowledge that all description inextricably involves negotiation with our normative and semantic conventions-of-describing, and we would do well not to hypostatise such conventions as themselves metaphysical structures.

⁸ Hintikka [1981a; 6] cleverly noted that it can be understood as the 'Principle of Paucity of Possibilities' as much as the 'Principle of the Plenitude of their Realizations'.

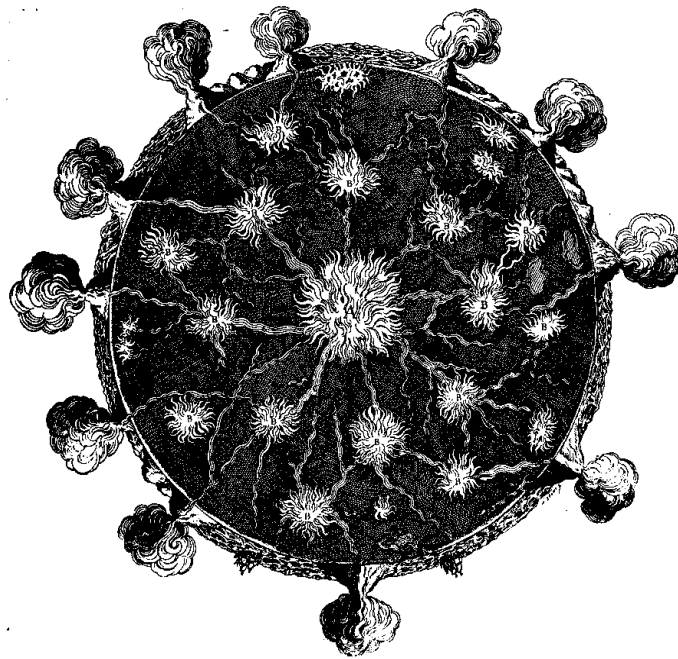
⁹ Paine: "[since] no part of our earth [is] unoccupied, why [should] the immensity of space [be] naked void, lying in eternal waste?" [2000; 304].

radius to be 6000km of abiotic churning. In other words, only when refracted through geology's localization of terrestrial life within time did earlier cosmology's expansive spatial depths first become truly terrifying: *we had to first realize the ancient death below our feet, before we discovered its canopy above our heads.*¹⁰

Planetary depth—never given to sense experience—was discovered only via its numerical construction: 'subterranean' had to shift from moral judgement to physical measurement. Considered Hades for the ancients and the region of Hell for medieval Christendom's 'infernocentrism' [Sloterdijk, 2014; 453], the Earth's core had long been considered *metaphysically distinct* from 'mundane' nature; on the basis, that is, of its interpretation, primarily, as 'moral opprobrium' rather than a natural and physical domain. Moreover, it was *deontologically* denigrated (inasmuch as Ptolemaic cosmography makes it the 'basement' of the universe) to an extent that *ontological* inquiry concerning its contents would have been considered precisely unjustified. A process instigated by Galileo during the sixteenth century changed this. Taking the precise physical measurements of Hell supplied by Dante and subsequent scholars, Galileo deployed geometric calculation to model whether these measurements could render a physically feasible structure [Galileo, 1943]. They could not. Here, 'depth' was subtracted of its inherent qualitative meaningfulness (as *locus terribilis*) and reformatted as quantitative extension: "the Tuscan artist" had used early mathematical modelling to evict Satan from the Earth's core, triggering its first admission into immanence with the rest of mundane nature [Platthaus, 2012; 36-7]. (Modern physics, ironically, was thus *forged in hell*.) Galileo's lectures on inferno mark the

¹⁰ Essential to the later, twentieth century formulation of Fermi's Paradox and its '*silentium universi*'.

beginning of his contribution to Copernicanism, yet the bowels of the planet are often overlooked when retracing the historical pathway of Koyré's Copernican 'geometrization of space' [1992]. Notwithstanding, where Descartes [2000; 261] would solely advertise the homogeneity of celestial regions *apropos* terrestrial space, Bacon [2011; 512] additionally extended such homogeneity downward to hypogene regions. Ushered thusly into the immanence, planetary depth became a new object for naturalist speculation: opening a vast arena within which to picture an entire suite of subsurface process. Savants began doing exactly this. By 1664, Athanasius Kircher's *Mundus Subterraneus* was the first to comprehensively map this domain (replete with underground dragons) with Earth's very first cross-section diagrams. Kircher's theory of "*Centrosophia*", moreover, argued for the *dignity* of the core within a cosmic hierarchy that had previously denigrated it [Leinkauf, 1999].



Kircher's "Geocosmos" [1669]

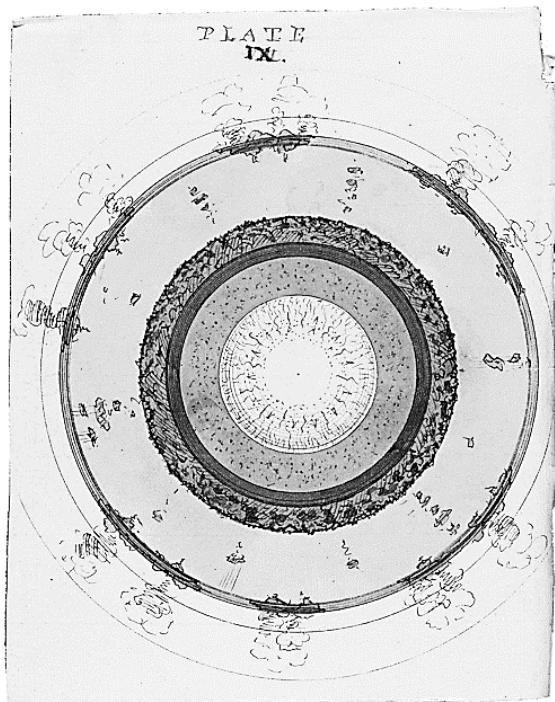
Thomas Burnet's tempestuous 1681 *Telluris Theoria Sacra* swiftly followed: here, Burnet imagined "open[ing] the Earth" and "[diving] down into the bosom of it, [to] see all the dark Chambers" [1965;

100]. His stormy depictions of crustal collapse and chthonic processes sparked an outpouring of physicotheologic ‘Theories of the Earth’: from Woodward [1695] to Whiston [1696]. These were ‘diluvianist’ (preoccupied with biblical flood), yet, nevertheless, attempted, by and large, to explain earth’s internal constitution *physically* rather than *morally*. In 1668, Nils Steno announced the pathbreaking ‘Stratigraphic Law of Superposition’: the founding gesture of geognosy. Steno’s Law kickstarted modern geohistory by first noting that stratigraphic succession stacks with temporal succession: ‘the lower the strata, the elder’. Or, *depth is time*. (Hence, centuries later, McPhee’s coinage of ‘deep time’ [1981].) Shortly thereafter, theorisations of deep-earth dynamics exploded during the eighteenth century. This became split between the thalassal ‘Neptunism’ of Werner and the igneous ‘Plutonism’ of Hutton; the former explaining stratifications as precipitations of a primordial *ur*-ocean, the latter representing earth-systems as hypogene magmic hydraulics. By PBS’s time, this split had modulated into the ‘Catastrophist-Uniformitarian’ debate, and geohistory had matured into science [Rudwick, 2005]. Given this, it soon became conventional to compare geology’s penetration of internal profundity to astronomy’s probing of outer deeps (exampled from William Herschel [2013; i.156] to Lyell [2009; i.166]), with Novalis dubbing geologists “inverted astronomers” [1992; 86]. Once lacking the requisite dignity to warrant inquiry, the lithosphere now presented riddles to rival outer-space. As of 1833, Lyell coined the word “hypogene” to technically nomenclate this new telluric netherworld [2009; iii.374].¹¹ This, coterminous with the dawn of chemistry, heralded the discovery of the inorganic

¹¹ A new-disclosed dominion demanded new-fangled legal codification: we see this in explicit reformulation of the property-law maxim ‘*cuius est solum, eius est usque ad coelum et ad inferos*’ (“whoever’s is the soil, it is theirs all the way to Heaven and all the way to Hell”); for, in opposition to Roman and early common law’s exclusive focus on airspace, eighteenth century jurists (namely, William Blackstone) first stressed the geophysical catchments of this dictum [Sprankling, 2008].

—from thine inorganic voice—

as inorganic. For, though the archaic “inorganical” had long referred (ironically) to something *incorporeal* or *spiritual*, “inorganic” in its modern scientific sense only appears around 1800 (with Richard Kirwan and Humphrey Davy first employing it) [OED, 1989]. The antonym of “organic”, therefore, was no longer supernal incorporeality but hulking death: hence, therefore, the important resonance of Cuvier’s ratio of $\approx 1599/1600$ s.



Thomas Wright, unpublished MSS, c.1773 [Eddy, 2007]

As explored, ‘matter’ was, prior to this, basically presumed to be *biogenic* or, at least, somewhere *implicated* within the organic kingdom’s economy and circulation (for, because ‘being’ is identical with ‘being justified’, plenitude also parses as the universalisation of utility). Cuvier [2008; 201] diagnosed this long-held metaphysical prejudice—traceable from Kircher to Lamarck—whereby naturalists believed “all the solid parts of the earth owe their birth to life” and, thus, “[e]ach of its parts is alive”. Contrarily, the discovery of an entirely abiotic kingdom, *absolutely unrelated to all organic circulation*, represented the debut of an entirely new domain of nature—one almost entirely invisible beforehand—

Hawkins lyrically encapsulated the menace of such pre-organic anteriority, writing of “*the eltritch-world uninhabitate, sunless and moonless and seared in the angry light of supernal fire*” [1834; 51].

Though orthodoxy had (ever since Earth’s age began bloating) endorsed mankind’s late-coming arrival, this prior absence of *any* organism at all was an altogether more threatening prospect. Coleridge, lucidly honest, decreed that he could not accept abiotic antecedence as “*objectively true*” because it would be “*subjectively humiliating*” [CM; v.285-6]. Or, if the cosmos is no longer essentially living then individual lives are severed from their synecdochal relation to the whole (i.e. the cosmic ‘life-support system’ of umbilical physics) and, thus, are no longer themselves in any sense essential. No longer ‘infinitely included’, organism is now ‘excluded’ by a surrounding medium of death, which is the same as saying that it is totally contingent. Contrary to interminable *ab ovo* preformations, if the entire biosphere emerged from the inorganic, it could well return to it.

PBS, in opposition to Coleridge, came to accept such antecedence, causing him to confront the precarity of human life; though, as we shall see, he could never coherently concede the full implications of this.

Already by 1812, PBS had acquired Parkinson’s *Organic Remains* (the first English book on fossils aimed at lay audiences) [PBS, 1964; i.214]. Around this time, PBS first ‘immersed’ himself in Buffon [Holmes, 2005; 80]. We recount the importance of this towering French scientist in the next chapter: for now, we note that Buffon was amongst the first naturalists explicitly to endorse human extinction’s potentiality and, moreover, fully incorporated plenitude-breaking irreversibility into his predictive model of Earth’s eventual and inconsolable refrigeration. PBS, notably, also read Jean-Sylvain Bailly: Buffon’s compatriot and peer, who extended this latter’s notion of thermic death to cosmic horizons

(more on both, later) [PBS, 2004; ii.614-5]. By 1813, PBS had met J.F. Newton, an eccentric vegetarian-utopian, who appears to have inspired PBS to include reference to “geological researches” (fossil evidences, specifically) within *QM*’s arguments concerning aeonic shifts in Earth’s axial inclination and the resultant climate change [2004; ii.256]. Newton himself had cited extinctions of mammoths as evidence for past climactic changes in his own work [1811; 13-6]. Both parties, accordingly, pinned their utopian hopes onto a long-term geophysical mechanism of orbital tilting [PBS, 2004; ii.255]. Certainly, ‘axis shifts’ and ‘equinoctial precessions’ had become somewhat of a hobbyhorse for political radicals (Shelley took the matter very seriously: ordering from Hookham “all possible documents” on the topic [1964; i.349]). For, as was frequently proposed contemporaneously, if earth’s axis was perpendicular to the ecliptic (i.e. not tilted), there would be no seasonal extremes (thereafter, materially inaugurating a long-awaited “Golden Age”).¹² Here, materialism and utopianism converge. Indeed, Charles Fourier [1808], idiosyncratic arch-utopian, subscribed strongly to this notion: axial nutation became the motor behind his grandiose world-history, wherein ecliptic perpendicularity eventually ushers in 70,000 years of perfect climate and perfected civilization (Fourier, however, was convinced this self-same utopia-manifesting nutation would also render the Earth eventually uninhabitable; inevitably shunting to the opposite extreme, wherein celestial poles and ecliptic become coplanar) [Godwin, 1996; 193-6]. Returning to the Shelleys, we see *Headlong Hall*—composed by PBS’s close friend, Thomas Love Peacock, in late 1815—depicting the characters “Mr Foster”, “Mr Jenkinson”,

¹² The matter was ‘astronomical commonplace’ [Godwin, 1996; 196]: debated from Burnet [1965; 175] to Bailly [1781]; the latter of whom PBS cites on the matter [2004; ii.255]. Notably, scientific discussions of axial inclination clustered around discussions of fossils and extinction mechanisms: from Halley [1723] & Hooke [1996] through to d’Holbach [Burkhard, 1977; 85-6] & Desmarest [Greene, 1996; 85].

and “Mr Escot” forecasting humanity’s long-term prospects. The setting, significantly, is Tremadoc: a remote location in North Wales where PBS had himself lived from 1812-13. The conversations and topics represented in the novella, evidently, portray real ones occupying the Shelley circle. Therein, the interlocutors echo Kant’s tripartite division between “eudaemonism”, “abderitism”, and “terrorism” concerning long-term futurity [1979; 145]: Mr Foster (explicitly channelling J.F. Newton and PBS’s theorisations) proclaims the “precession of the equinoxes” will “gradually ameliorate” humanity’s “physical state” and trigger the “final step of [perfect] intelligence”; Mr Jenkinson, contrarily, claims that axial shift will have null influence; whereas Mr Escot predicts shifting inclination will promulgate “convulsion[s]” that “will continue to roll on, [with] expansive power [and] accelerated impetus, till the whole human race shall be swept away in its vortex” [1816; 95-6].¹³ Peacock wrote this in 1815, the year he and the Shelleys boated up the Thames together: this excursion, providing much of *Headlong Hall*’s material, clearly saw such topics being discussed by the party. It is specifically following this period that PBS’s descriptions of nature shift from homeostatic to baneful. Certainly, a *Blackwoods* reviewer of 1816’s *Alastor* criticized an excess of “mineralogical and geological observations”, pronouncing that such ‘spelunking’ within the “interior of the earth” isn’t “worthy of a poet” [anon, 1819a; 149]. (“Geological” being a newly coined word—of technical connotation—the pointedness here is revealing [Rudwick, 2005; 134-5].) This ‘unpoetic’ preoccupation would only gain intensity after PBS and MWS’s 1816 journey to the Alps. June saw their stay with Byron, during which Byron

¹³ Foster next claims that there will be a time when “moral science will be susceptible of mathematical demonstration” and “universally recognised”. Escot sardonically agrees that such cooperation will happen, *if and only if*, 999,999/1,000,000s of humans are extinguished. To which Jenkinson tenebrously adds that “if only we three were survivors of the whole system of terrestrial being, we should never agree in our decisions as to the cause of the calamity” [1816; 108-9]. Again, ‘perpetual peace’ only in extinction.

enthusiastically introduced PBS to Cuvierian catastrophism [Brewer,1994; 27-36]. In July, the Shelleys visited the Chamonix glaciers. Thereafter flagging this montane experience as a watershed in his own self-mythology, PBS famously wrote to Peacock stressing “Buffon’s sublime but gloomy theory”, wherein the Earth “will at some future period be changed to a mass of frost” [1964; i.499]. PBS’s ‘Mont Blanc’, indeed, ventriloquises these glacial flows as prophets of this future extinction, as an abiotic “flood of ruin” tending inexorably toward:

overthrow[ing]
The limits of the dead and living world,
Never to be reclaimed.

[ll.112-3]

Plenistic homeostasis empties into irreversible dissipation; future perfect terminus is here witnessed as entropic frost glacially creeping backwards out of the future; glaciers, in their telic crawl, are invasions from Buffon’s icy futurity. No longer balkanised by “[l]iving globes which ever throng” [‘Ode to Heaven’, ll.12], the inorganic gains a sovereign autarchy and ineliminable extrajudiciality—tending towards cold antagonism—*apropos* life. Following 1816’s revelations, this new awareness takes hold: 1818’s *Laon & Cyntha* is comprehensively littered with geo-catastrophic metaphor; indeed, the poem is a masterclass in PBS’s usage of analogies between political revolutions and geohistorical cataclysms [Duffy, 2005]. By 1821, PBS requests from his publisher “copious” histories of “Geology” and the “best modern geological works” [1964; ii.269]. Consequently, he received a treatise by one of Werner’s students [D’Aubuisson, 1819] and, later, Cuvier’s compendious *Recherches* [1964; ii.458]. And, just months before his untimely death in 1822, PBS reported himself enraptured by these tomes, consuming them eagerly [1964; ii.276].

3—PLANETARY DEPTH PSYCHOLOGY

PBS's idealism was of a metaphysical, decidedly uncritical, bent: his was a pantheistic Berkeleianism; a nature-intoxicated Malebranchianism. A Platonically-inflected 'realism of the idea' [Dunham et al., 2011], one that sees individual minds as regional contractions within a cosmic ideational field. "I, you, & he are constituent parts of this immeasurable whole", he theorized [1964; i.215]. Thus, where PBS intones "[a]ll things exist as they are perceived" [2002; 533], this is intended to refer to individuated existents as the serial *percepta* of nature itself, as the maximally real "One Mind" and "existing power of existence". Influenced by Platonic traditions, PBS propounded an emanationist idealism from his juvenilia onward; casting "the Universe" as a "mass of infinite intelligence" [1964; i.215]; whilst tracing natural history as the unfolding perceptions of this "vast intellect [which] animates Infinity" [1964; i.35].

Nonetheless, upon having imbibed what one commentator, in 1814, called the "reveries of the geologists [in] marking out an epoch anterior to the existence of living beings" [Chalmers, 1848; 364], PBS's mature idealism becomes exacerbated in its attempt to ingest the ≈1599/1600s of tellurian mass indivisible to the life of mind. Ever since the mid-1810s, his emanative source becomes more distal, more absconded—*more hypogaeae*.

Attesting, by 1818, the folly of assuming the "cause of life could think and live" [*L&C*, ll.3237], PBS's imagistic arsenal begins to extend previous river metaphors (stemming 1815's Thames journey) to limn for consciousness a chthonous origin: for "we know not whence we live" and "our thoughts flow" thus with a "stream, whose waters / Return not to their fountain" [*L&C*, ll.3775-6]; these "secret springs"—the "source of human thought"—arrive from the bedrock of being, often figured as a

subterrestrial “tribute” [‘Mont Blanc’, ll.4-5] within “voiceless depth” [L&C, ll.4230]. The individual, therefore, speaks with a “sound but half its own” [‘Mont Blanc’, ll.6]. This “fountain” or “secret source” is the “soul’s abyss”, which

like some dark stream
Through shattered mines and caverns underground
Rolls, shaking its foundations
[‘Athanasie’, ll.98-104]

In the fragmentary ‘Speculations on Metaphysics’, PBS wrote that

A catalogue of all the thoughts of the mind [is] the cyclopædic history of the Universe.
[1912; ii.186]

This model is identical to Schelling’s, who expounded that

one who could write completely the history of their own life would also have,
in small epitome, concurrently grasped the history of the cosmos
[2000;3-4]

PBS wrote of each individual’s “faithful history” as being equally profound [1912; ii.185-6]. Such sentiments were embodied, scientifically, in ‘Recapitulation Theory’. Made infamous by Haeckel post-1860, recapitulation finds its true roots in the *Goethezeit*: stating that individual development *retraces* cosmic evolution; transliterated embryologically, as the Meckel-Serres law, the principle famously declares that ‘*ontogeny repeats phylogeny*’ [Gould, 1977]. As a motivating tenet of natural research, recapitulation originates with Schelling and his disciples, the German *Naturphilosophen* (including Steffens, Oken, Schubert, Ørsted, and Treviranus) who promulgated a dynamic picture wherein “with every organic product Nature passes through all [prior] stages” [Schelling, 2004; 140] and, therefore, each individual represents an arrested “stage of development” within the “true *history of the Earth*”

[Steffens, 1801; 96].¹⁴ This schema emerges as an extension and reconfiguring of the volvox-model of prior metaphysics: the organism ‘includes’ total history within itself, because it is, in turn, perfectly ‘included’ (i.e. accounted for) by total organic history. Recapitulation, indeed, is nothing but idealism’s Principle of Identity re-stated naturalistically and embryologically: ‘A=A’ enacts repetition with iterative differentiation, tying palingenesis to caenogenesis, or, reproduction to evolution. Yet, due to interim discoveries regarding inorganic autonomy, key differences emerged—suitably inflaming the inclusivist worldview from within.

For, as the vast spatiotemporal preponderance of the subject’s “cyclopædic history” is abiotic and ante-organic, the majority of one’s “epitome” utterly cannot be, as PBS wrote, “subject of sensations” (i.e. assimilable to intentional consciousness). Nonetheless, PBS and the *Naturphilosophen* were convinced they must still “be included in the catalogue” of noesis. Therefore, they must still be ‘contained’, but as *pre-conscious episodes* or *mnemonic traces*. They are thus ‘contained’: but only as a form of self-alienating irrecoverability, or, *depth*. For Percy, “a faithful history of [one’s] being, from the earliest epochs” would circumscribe “cyclopædic history”, and yet,

thought can with difficulty visit [its] intricate and winding chambers

[1912; ii.190]

Similarly writing that one’s true biography would recapitulate universal cosmogony, Schelling noted that many “turn away” from the “depths” that are, therefore, “concealed within themselves”; we “shy

¹⁴ From here the idea spread throughout Europe: to Dr Malfatti [1809] in Italy; to Coleridge [1995; ii.1194] and his protégé J.H. Green [1840] in England; before becoming indispensable to mid-century ‘transcendental morphology’.

away” from the “glances into the abysses of the past” which remain within us “as much as the present” [2000; 3-4].

As per recapitulation, ‘noogeny’ repeats and includes ‘geogeny’: yet, if noesis contains this abiotic precedence, then \approx 1599/1600s of mind is opaque and inaccessible to itself. (This is dramatized by PBS’s images of spirit’s ‘upstream’ irrecoverability: its “secret source”.) Having claimed philosophy is “nothing other than a *natural history of our mind*” [1988; 30], Schelling stumbled upon this so-called “past-in-itself” [1978; 119-4] and saw that—insofar as one tries to include it in mind’s “catalogue”—it retracts infinite divisibility and telescopic self-similarity from mindedness by introducing a form of “indivisible remainder” [2006; 29]: a surplus unassimilable to cognition yet, Schelling believed, somehow productive of it. Consciousness becomes riven, from within, by its prehistoric preconscious.

In other words, the notion of *unconscious memory* first emerged within intellectual history as the attempted synthesis between absolute idealism’s Principle of Identity and modern Natural History’s inorganic anteriority: the former had long stipulated all existents as infinitely contained within ideation’s inclusive “catalogue”; yet, this collided with the latter’s emendation of existence’s gigantically dead spatiotemporal provenance and its postulation of items absolutely not the object of any apperception; recapitulation theory, as part of Schelling’s [1988; 30] prospectus of ‘genetic philosophy’, arose as an attempted compromise between ‘world-time’ and ‘life-time’, yet this was only secured by sacrificing continuity and its auxiliary premises of self-similarity and infinite divisibility. Or, when the “infinity without” becomes, for the organism, ‘excluding’ rather than ‘including’, then the “infinity within” concomitantly becomes formatted—not as the *perfect recall* of preformation’s infinite inclusions—but as the irrecoverable depths of *abiotic amnesia*. As such, the concentric homogeneities

of prior idealisms became ‘intussuscepted’ or ‘everted’ into the heterogenous stratigraphic depths of an externalised unconscious; or, through the eighteenth century’s discovery of abiotic history, idealism’s transparent self-inclusivity mutated into the opaque self-exclusions described by nineteenth century depth psychology.

Simply put, *the filtration of absolute idealism through earth science provided the specific matrix of concepts that first enunciated the unconscious*. We linger on this precisely because this curious genesis of ‘the unconscious’ can be triangulated as the inflammatory self-obsolencing of the ancient philosophical stance that maximally identified ‘reason’ with ‘being’ (thusly prohibiting conception of any extinction of reason). It arose, that is, as a final defence of ancient convictions in nature’s hospitality (against modern techno-science’s discoveries to the contrary): a last protective compromise that slid into auto-immunity, and, by consequence, replaced the ancient tradition of idealist metaphysics with the modern legacy of the unconscious.

Schelling and his peers, certainly, are often cited as the first explorers of the unconscious’s continent [Ffytche, 2012 & McGrath, 2012]: the so-called “*Nachtseite der Natur*” [Schubert, 1808]. And yet, in this inceptive permutation, it was a radically *ectopic unconscious* (as opposed, that is, to the idea’s post-Freudian reception as exclusively a psychological and brain-bound domain), for, here, it was taken to permeate the entire external universe and was attributed, specifically, to abiotic processes. For, as Schelling concluded, spirit’s “unfathomable” deeps *just are* “what is oldest in nature” (i.e. its lapidary, ante-organic stratifications) [2000; 85, 31]. And thus, inorganic strata were considered, quite literally, to be preconscious memories. (Looking throughout the period—from Franz Mesmer [1779], through Eduard von Hartmann [1869], to Samuel Butler [1880]—all of its nascent theorisations of the

subconscious are similarly ‘ectopic’, or, psychologically decentred and cosmologically extended [cf. Nicholls & Liebscher, 2010].)

The “caverns of mind are obscure”, PBS professed [1912; ii.185]. Here, we can rightfully interpret his symbolic intention as tautegorical rather than merely allegorical: the “cells”, “dim labyrinths”, and “unimagined caves” of “thought” [2010; ii.333]—those recurrent “caverns of [the] mind” [‘Julian & Maddalo’, ll.573]—are quite literally *also* the chthonous adyta of pre-biotic history.

The geocosm is an unconscious; the planet its ectopic memory-bank.¹⁵ Indeed, ever since *QM*, PBS had identified morphogenesis with mnemonic inscription [VII.54-5], writing that life is a “store [of] all events [that] variegate [the] universe” [IX.158-60]. And yet, *QM*’s telescoping transparency of vitalistic preformations later transmutes into the irrecoverable “ruins” of telluric deeps. This duly transformed the poet’s early obsession with Platonic “pre-existence” [Givens, 2010; 242-4] (or, in his and Godwin’s coinage, “antenatality” [PBS, 2010; ii.318]) from a paradisaically perspicacious recollection of life’s *ab ovo* self-inclusions and into the alienating inner-trace of outer-time (whereby the organism contains the ‘recollection’ of its own death, so to speak). For, where previously one compacted “memories of an antenatal life” [‘Athanasie’, ll.91-2] (as a mnemonic transposition of Spallazani’s preformationist “argument for inclusion”), individuals now, instead, embed encrypted traces of the buried “monuments” of unconscious and abiotic “history” [1964; i.485]. (Due to this, individuated and subjectivated existence becomes legible as a form of *retrograde amnesia*; and, concomitantly, the

¹⁵ Ziolkowski [1990], Clinger [2013] and Sommer [2003] have explored similar themes across German and British Romanticism.

‘perfect recall’—or ‘anamnesis’—championed by preformationist “antenatality” is now accreditable as total *inorganic recidivism*, or, *death*.)¹⁶ Indeed, already in the Alps, PBS described lithic formations as “monuments of things [once] familiar”: declaring them “lost memories” of the “one mind”; a “mind so powerfully bright as to cast” a “shade” of forgetfulness “on the records that are called reality” [1964; i.485]. (Schelling often spoke of the “memorials” and “monuments” of consciousness’s “transcendental past” [1994b; 109-10].) Such ‘traces’ refer to omissions and absences rather than any uninterrupted tradition: hence, the metaphors of “ruins” prevalent in contemporaneous psychological discourse [Sprengrer, 2008]. Appropriately, Louis-Sébastien Mercier took up such ideas in talking of an “uninterrupted tradition of natural disasters”, continuous from physical into psychical domains, with the mind of man imprinted, accordingly, with “terrors of ancient upheavals” just as much as tellus itself bears “profound traces of ruins and devastations” [1785; i.5]. Elsewhere, De Quincey stated that “convulsions” inscribe “themselves successively upon the palimpsest of your brain [in] endless strata [of] forgetfulness”: a predicament he continuously aligns with the “*primary* convulsions” of “our dark planet” [2009; 194].¹⁷ This outlines the psychosomatic transposition of Steno’s Law common across

¹⁶ Recapitulation atomizes the monolithic homogeneity of the present (Aristotle’s “*synecheia chronou*”), disarticulating its infinite continuity into an exploded-view cross-section of ‘heterochronies’, or divergent evolutionary-developmental stages. As Schelling wrote, “[i]n the bones of animals the soils are hardened, and their veins conduct metallic content” [2004; 118]. Pathology, thereby, becomes legible as ‘temporal nosology’—or, an unravelling of somatic coequality—with Coleridge speculatively diagnosing “nervous diseases” as recrudescing eruptions of “ante-organic activity [in] the nerves” [CN; iv.4580]. Disease is now understood as “Relapses ⟨of Nature⟩” or “Sinking [back] from the organic and vivific” [CM; i.664]: a form of ‘time sickness’. *Ergo*, ‘*anamnesis*’ is *death*.

¹⁷ De Quincey wrote that the “*virtual* time” of dreams is “ridiculous to compute” in scales “commensurate with human life” and must, contrarily, be measured in “diameters of the earth”—in “æons” and “millenia” [2009; 154]. PBS’s Laon, likewise, relates “visions of a dream” that “did seem”

Romanticism. And we must witness it as in line with PBS’s metaphors of “elemental Genii, who have homes / From man’s high mind even to the central stone / Of sullen lead” [PU, IV.539-41]; or, his imagining that earth’s “rent heart” houses “spirits / Whose homes are [also] the dim caves of human thought” [I.658-61]. Geology, then, is the physics of the unconscious. And, with this, we note the transformation of spheres from expressing transparent self-inclusivity to instead denoting self-excluding profundity.

Bloch wrote of Romanticism’s ‘inorganic unconscious’, which it developed as defensive immune-response against encroaching ‘death’ [1986; iii.1153]. That is, though seemingly inflaming ‘therapeutic idealism’ into ‘baneful idealism’ [Krell, 1998], unconscious depths ultimately operated as merely a new-

to “ten thousand years outnumber / Of waking life”: therein, Laon sees a “boundless chaos” whose “limits yet were never memory’s theme”. This ‘deep time of the oneiric’ compacts an entire Buffonian cosmogony, from planet-formation up to Laon & Cyntha’s first emergence, in Adamite and troglodytic fashion, into an Edenic primaeval nature:

Two hours, whose mighty circle did embrace
More time than might make grey the infant world,
Rolled thus, a weary and tumultuous space:
When the third came, like mist on breezes curled,
From my dim sleep a shadow was unfurled:
Methought, upon the threshold of a cave
I sate with Cyntha;

[II.1108-1125]

First off, “ten thousand years” correlates exactly with the 10,000-year units that constitute the titular ‘epochs’ of 1788’s *Époques de la Nature*. In this work, Buffon theorised the Earth was created by molten matter expelled from the Sun. Earth’s primordial molten ball, cooling over time, then gained a crust. Laon’s reference, above, to the “infant world” becoming “grey” nods to this. Importantly, Buffon’s conjectures stated this crustal cooling would take 20,000 years/two epochs: or, “[t]wo hours” within Laon’s oneirological time-dilation. Moreover, the emergence of Laon & Cyntha on the scene (an abiogenetic event likened to a shadow “unfurled”) corresponds perfectly with Buffon’s tracing the beginning of Earth’s habitability to 30,000 years, thus PBS’s “third” hour. These striking correspondences have, heretofore, gone unnoticed.

fringed medium of support. Responding to geology's wholesale expulsion of vitality from nature, metaphysical idealism conceded ground by growing a geocosmic unconscious, yet such profundity still nonetheless functioned to retain a heartland—or *foundation*—for conception within non-conceptual nature (no matter how ancestrally absconded or cognitively opaque). No longer subordinating independent nature to jurisprudential reason, this new schema instead submerges discriminating reason within unconscious nature's depths: yet, either way, the result is similar, in that both absolve reason of having to track the propriety of its contents relative to existence, because there is foundational identity between the two—even if it consists in overflowing unreason rather than exhaustive judiciary—such that, disincentivized from tracking the proprieties of its concepts, neither is mind motivated to discover or admit their contingency. Our point is that post-Kantian idealisms, though seemingly responsive to geoscience's discovery of the abiotic, still fail to concede its full implications in their attempts to retain 'belonging' through still retaining foundations (even if this is now churning, preconscious "*Weltseele*" rather than pre-established harmony). "*Ungrund*" remains "*Grund*", and 'belonging'—despite subsisting in tragedy or traumata—remains 'belonging' nonetheless. We turn to PBS's grappling with this through his figure of "Demogorgon".

4—GEOPHYSICAL VOLUNTARISM

Kant's pathbreaking demarcation of the *irreducibility* of the 'transcendental' over the 'empirical' was intended as normative and deontological in scope, rather than substantive or ontological. Namely, he noticed that the discursive rules that alone make empirical description possible—through mapping apposite and inapposite applications of descriptive concepts—involve questions of '*ought*' which are irreducible to denotations of '*is*' (or, are inextricably value-laden rather than fact-based) and are thus

not themselves objects of empirical description. However, along with other post-Kantians (from Maimon to Fichte to Coleridge), Schelling mistook this irreducibility as substantive in scope (whether deliberately or not). He inherited Kant's 'transcendental' as denoting an *ontological domain* in excess of the empirical one. Broadly, the early Schelling identified this excess domain with natural history (given recent discoveries of the latter's spatiotemporal precedence over the empirically available). Therefore, Kant's methodological partition of 'transcendental' and 'empirical' is remapped, within the terminology of *Naturphilosophie*, onto the ontological surplus of nature's unconscious productivity over its conscious products. This allowed Schelling to articulate nature's contingency and excess over human consciousness. Yet, insofar as Kant's transcendental demarks the *essentially moral* category of unconditioned autonomy, Schelling was led to hypostatize "freedom" as an essential quality of prehistoric nature. Thus, having reified this moral quality, any *true* contingency of ethical value is compromised. This is embodied in the "*Ungrund*" of 1809's *Freiheit* essay (denoting an anarchic voluntarism in "the depths of the natural ground", or, the "incomprehensible base" and "primal will" of "primordial nature" [2006; 29-32]). For, through establishing this "omnipotence of nature" [2006; 45], Schelling can, on the one hand, appear to endorse full-scale natural contingency and, accordingly, nature's seeming autonomy from the human (duly talking of a "new race" eventually replacing *Homo sapiens* [Grant, 2006; 55]), and yet, on the other hand, and insofar as Schelling has got here precisely by reifying value-laden notions of "freedom" and "will", he cannot coherently and imagine the untrammelled extinction of all moral value and activity *simpliciter* (indeed, his "new race" is *justified* as having "new organs of thinking" [Schelling, 1989; 57]). Humans may disappear, but recognizably sapient values will return. As we shall see, *Prometheus Unbound's* "Demogorgon" (described in terms

—from thine inorganic voice—

tellingly similar to Schelling’s “abyssal freedom”) fulfils precisely the same role for PBS: a dramatization of nature’s excess over the human; yet one that ultimately is unable to underwrite or actualise sapient value’s irreversible extinction.

For Schelling, the individual’s “particular will” is an echo of the abyssal will: an inheritance detectable as a “hidden voice” within us [2006; 47]. In Act.I of *PU*, Prometheus addresses the “Grey mountains”, “tongueless Caverns”, and “Prophetic caves”. He commands the planet:

Speak, Spirit! from thine inorganic voice

[I.135]

It answers only with “echoes”: yet through the ‘Dark Interpreter’ of the lithic landscape’s reverberations, Prometheus hears “what yet [he] cannot speak” [I.250-3]; thus granting, through echoic mediation, a “voice” to PBS’s geocosmic unconscious. (What’s more, “inorganic” was, as already observed, then an entirely novel term; further, PBS’s deliberate deployment here presents its *very first* recorded instance in poetry [OED & Mishra, 1994; 182]; and, arising from a newly-established technical field, it would have arrested contemporary readers as idiosyncratic, or, barely “worthy of a poet”.) Yet this “inorganic voice” is not only constrained to inert echoes but is granted seismic potency in the figure of Demogorgon: a “voice of flames far underneath” [*L&C*, ll.2892].

PU’s palaeontology of spirit, that is, descends to the “dark void” and “abyss” at the lithosphere’s magmic core [III.ii.10]. In Act.II, Asia and Panthea—led by more inorganic echoes—make their descent to this “world unknown”,

to the realm
Of Demogorgon, [through] the mighty portal
Like a Volcano’s meteor-breathing chasm,

[II.iii.1-3]

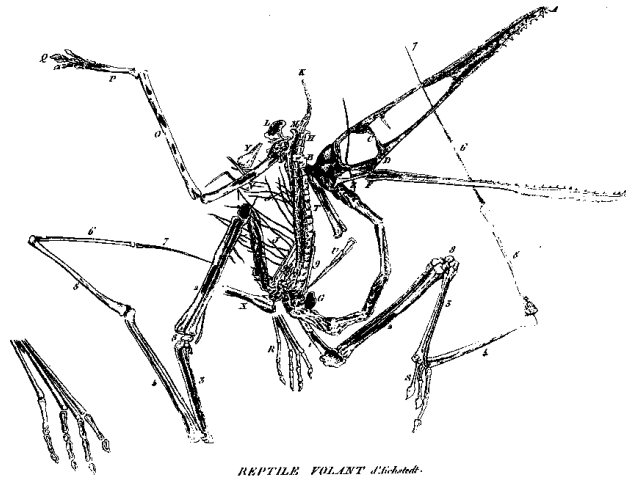
As Matthews [1957] first pointed out, this *descensus ad inferos* is a drop under the mantle through the caldera of a volcano. And here lies the Demogorgon, shadowy and potent. An “Earthquake-dæmon” and “unknown omnipotence” [‘Mont Blanc’, ll.53 & 72], this “supreme tyrant” [I.208] represents a power “[m]ightier” even than Jupiter within the drama (by Jove’s own admission [III.i.44]): for, in the end, it is this chthonic dæmon who unseats and overthrows the God of *PU*’s mythos [III.i.70-83]. (Opening Act.III, Demogorgon’s “Earthquake” is seen “thundering [up] Olympus” to drag Jupiter down to his magmic oceans of “tempestuous fire” [III.i.150-175].) Thus, just as Schelling described his “*Ungrund*” as having precedence over God’s right-minded will, Demogorgon is similarly positioned as the most “Primal Power of the world” [Shelley, 1839; ii.134] and is described (again just like Schelling’s will) as basal and prehistoric anarchy. As the “Doom coiled underneath” [II.iii.97], Demogorgon, just like Schelling’s “dark ground”, is the *potentia absoluta* to God’s *potentia ordinata*. He is the unruly ‘Id’ of the poem’s global epipsyche.¹⁸

Crucially, for both, each of their primordial omnipotences are explicitly related to species extinctions. Schelling relates the *Ungrund*’s potency to the evidences of “previous world collapses”; to the “series” of “perished” species populating terrestrial strata; and to the geophysical “forces of the ground” that lord over earthly epochs [2006; 45].¹⁹ Likewise, the telluric realm of Demogorgon (who is seen seated on a magmic “throne / Of burning gold” [I.208]) is revealed as compacting the fossilised

¹⁸ Whereas *QM*’s epigraph quotes Archimedes on shifting the earth with his fulcrum, *PU*’s quotes Aeschylus addressing a chthonian and oracular hero from their “home beneath the earth”: no longer manipulable balloon, planet earth is home to lurking fiat.

¹⁹ Schelling’s colleague, Eschenmeyer, complained of a preoccupation with geology in Schelling’s essay on ‘human freedom’, exclaiming that it everts “ethics into physics” [Grant, 2006; 202].

“bony chains” of “earth-convulsing behemoth” and “monarch beasts”—jumbled betwixt “anatomies of unknown wingèd things”—all of whose earthly dynasties were abruptly “abolished” [IV.295-318].



Cuvier's “ptero-dactyle” [1809]

Thus, as already implied, this hypostatization of “unknown omnipotence” as “*ancient nature*” (exemplified across both PBS and Schelling’s work) operates to symbolically enact the new-found range of natural contingency opened up by geophysical researches. Yet, as we shall see, this articulation of contingency is ultimately stifled by the residual foundationalism of their theories of geocosmic preconsciousness.

5—SUBDUCTED POSSIBILIA

With omnipotence comes *unrealized possibilities*. Demogorgon, as hypogene omnipotence, resembles the unmistakably numinous magmic core of plutonist geology (which Playfair had described as a “moving and expansive power” lodged at “very considerable depth” in the “bowels of the earth” [2011; 104]).²⁰ And, just as Hutton’s plutonic power was related by contemporary commentators to

²⁰ Cause of both “earthquakes” and the “intensity of volcanic fires”, the Scottish naturalist enjoyed foregrounding the sublimity of plutonism’s molten heart, advertising that it “alarms the imagination”

“worlds yet unborn” [Macculloch, 1831; i.219], PBS conspicuously depicts volcanological witness to germinal futures in *Laon & Cyntha*: Cyntha, incarcerated within a littoral cave, peers downward into the “deep’s wealth” and—spying mineral “engrav[ings]” of “mystic legends by no mortal hand”—witnesses submerged and “kingless thrones, which Earth did in her heart create” [ll.2938-6]. This clearly references Hutton’s model of total terrestrial fungibility by way of volcanic retexture: whereby he imagined the “formation of a future earth” as strata currently being cooked within the mantle and being expelled at “the bottom of the ocean” [1788; 89]. (Playfair: “we cannot doubt, that strata are now forming” which will “raise [new] continents” [2011; 129].) Such retexture was easily analogized as the dynastic cycles of “kingless thrones”. Of course, insofar as Huttonian uniformity is a subtype of plenitude, these “worlds yet unborn” were accredited only insofar as they are *utterly identical with our own*; thus, insofar as the ‘future’ is precisely just the disinterment of the deepest ‘past’, Huttonianism enforces a kind of ‘preformationism of worlds’; and yet, as we explore fully in coming chapters, the competing model of Cuvierian catastrophism was to entirely unconstrain possibility from the extensional limits of the currently actual, thusly endowing the earth-system with a strong contingency extending to entirely unrealized possibles (the implications of this become relevant later). Put simply, geology opened up not just the planet’s physical depth but, also, its modal depth: it radically extended the ‘terrestrial possibility space’ (beyond the conditions of vitality and thought, specifically).

Already in 1681, Burnet wrote that “some two Planets”, during the same “Period”, don’t “so much differ from one another, as the same Planet doth from itself, in different periods” [1965; 140]. Of course,

by the sheer “powers” it implants within “subterraneous regions” [2011; 147]. Just like Playfair’s “original fluidity” [2011; 493], Demogorgon, too, operates as plutonic world-pump.

—from thine inorganic voice—

this understanding (deploying a spatializing heuristic) still presumes possibility exhausted by extensional definition (i.e. ostension to actual instances), yet, by Cuvier's time, terrestrial contingency had been unlimited of even this constraint. As such, it had become conventional to imagine the planetary-core as home to "*wrecks of worlds unknown*" [Drummond, 1811a; 50]. Looking back from 1838, G.F. Richardson attributed to Cuvier the discovery of "fresh world[s]" in the earth "beneath" us: a discovery he, and others, compared to Newton's colonization of worlds "above" us [1838; 2]. Yet, in catastrophism, these "worlds" were allowed to diverge entirely from the limits of the actual. Or, in other words, the supernal "pyramid" of "possible worlds" from Leibnizian *Theodicy* [2014; 261-2] had been inverted and transposed underground: in a crustal subduction, Leibniz's '*mere possibles*' were convected underneath the mantle and imagined to subsist chthonically as pure potentia. (This explains PBS's imagery, in *Witch of Atlas*, demarcating "enwombed rocks" as incubators of chimerical possibles: as the "chrysalis" receptacles of ontological apocrypha [ll.126, 162].)

Via geohistory's admission of unrealized possibles, stratigraphic descent became reconfigurable as a katabasis into the domain of possibilia. We see this in both PBS's *PU* and Byron's *Cain*. Regarding the former, Panthea and Asia's *descensus* (refrained with "Down, Down!") unfurls as a regression through concrete actuality to pure potency. Each stanza, that is, peels back a layer of reality: first, we drop beneath the tangible objecthood of "things which seem and are"; second, beneath reality's interlocking substructure of qualities, properties, and "time"; third, through the *via negativa* of "void Abyss" where things "are not"; and, finally, we bottom out onto Demogorgon's meontic dominion. This latter is likened to purely unactualized potentiality:

–chapter.1–

In the depth of the Deep,
Down, Down!
Like veil'd Lightning asleep,
Like the spark nursed in embers,

[II.iii.54-98]

Similarly, in 1821's *Cain*, Lucifer guides the eponymous hero, *descensus ad inferos*, to the archive of "vast [...] dim worlds" within our planetary-core [II.ii.1]. This "Hades"—or world-repository—contains "past leviathans" [II.ii.189] and "mighty phantoms" [II.ii.44] of fossil facsimile, including a "mammoth" [II.ii.142-3]. (Byron's vision, admired by PBS, is fruit of the former's reading of Cuvier: the preface explicitly flags this [1968; 157].) *Cain*'s world-library not only houses "phantoms" of "beings past", but likewise

shadows still to come

[II.i.175]

These jumbled possibilities and previous extinctions are reported to outweigh the "luminous orbs" which populate the "upper air" [II.ii.2-3]. Moreover, when asked whether these "swimming shadows" will "live" or have "lived", Lucifer replies [s]omewhat of both" [II.ii.33-4]: thereby implying the chimerical borderland of *genuine unrealised possibility*. Unrealised possibilities, as already established, are yawning gaps in the metaphysical idealist's identification of 'justification' and 'existence' (i.e. they are things that *could* exist, but simply *do not*, without *any* further justification). Admitting of them is to admit irreducible unjustifiabilities within nature—and, thus, it is to cleave the foundationalist identification of the fact of existence with the value of jurisprudence—such that the natural fact of the extinction of sapient values first becomes feasible. In appropriate fashion, Lucifer duly intones that, just as these

fossilised “Reptiles” [II.ii.97] and “enormous shapes” [II.ii.31] were exterminated “from their earth, thou wilt fade from thine” [II.ii.75].

Geology, by breaking plenitude and introducing unjustifiability into nature, first legitimated propositions upon the end of all justice. Byron ingeniously dramatizes this by imagining an inverted pyramid of possible worlds containing the epitaph of our future extinction. To conclude, we explore how PBS’s own imagining of terrestrial possibilia *seems* to contain this threat yet ultimately cannot appraise or support it. Before this, however, we explore another imagining of ‘underground omnipotence’ that represents the first long-form literary treatment of human extirpation.

6—ABSOLUTE STAKES

February, 1805: Jean François Xavier Cousin de Grainville commits suicide, throwing himself into a canal, disillusioned with France’s revolutionary course [Paley, 1991; 67]. Shortly thereafter, his tenebrous masterwork was posthumously published, to little immediate fanfare: *Le Dernier Homme* and its author are ‘forgotten’ [Majewski, 1963; 114], yet Grainville’s intensely idiosyncratic prose poem singlehandedly ‘inaugurated the mode’ of the Last Man [Clarke, 2013]. This obscure quasi-Milonic epic, projecting the “latter days of the earth” [1806; i.10], operates as a negative theodicy for a disappearing god: for, operating as ‘vanishing mediator’, it retains an apocalyptic and theistic scaffolding, yet conserves this chiliastic shell largely as the cover within which to first gesture towards the terminality of modern extinction.

Grainville, that is, extrapolates a “dark futurity” [1806; i.6], wherein exhaustion is universal and non-conciliatory: “marriage had [ceased] to procreate” [i.35]; the entire globe is “stripped of verdure”; everything presents “melancholy features of decay” [i.21]. The model for this “decay of the universe”

[i.22] is essentially dissipative: following the contemporary trend, initiated by Buffon, toward conceptualising physical process as irreversible and asymmetric rather than consolable and homeostatic (more on this in Chap.2) [Tresch, 2012; 104]. What marks Grainville out, that is, is that prior visions of ‘decay’ contain some conciliatory reference to replenishment—by way of plenitude—yet this is here conspicuously absent. Here, the withering Earth “behold[s] its final race of inhabitants” [i.35] and the survival attempts of this “last race of man” [i.9], as played out within the narrative crucible, are all sequentially thwarted.

Grainville catalogues humanity’s previous, miscarried attempts toward restarting terrestrial fecundity—Promethean techno-scientific feats of geoengineering, terraforming, and climate-modification by way of gigantic “engines” move “ocean” and “mountains” [i.110-7]—yet these projects serially culminate in exhausting failure. Accordingly, our protagonist, Omegarus (a ‘terminarch’ typology of ‘Adam’) is left as humanity’s final hope to continue the species: he is tasked to “regenerate” the world [i.46] by bearing offspring with Syderia (the corresponding ‘terminal Eve’).²¹ Yet, the pair do not consummate, and *Homo sapiens* senescens to the void. This isn’t down to accident, however, but to Divine Decree.

God, that is, intervenes to reveal Omegarus’s given task of perpetuating existence’s *vallis lacrimarum* as misguided and wrong. Instead, divinity exhorts humanity’s extinction as both *desirous* and *righteous*, doing so by transporting a prehistoric Adam forward-in-time to the future earth to persuade Omegarus of this message: to renounce Syderia and thus to hasten the divinely-sanctioned euthanasia of universal nothingness.

²¹ ‘Terminarch’ refers to final member of a species: the last instance of a dying kind [Andrews, 1996].

—from thine inorganic voice—

In a temporal recursion—inclosing *all* of human history within its suicidal loop—the ‘First Man’ convinces the ‘Last Man’ to abort the human race. This self-abnegating looping, by collapsing firstness into lastness, effectively cancels the meaningfulness of human time *in genere*: mankind was *already-already* miscarried. World-history is divided by zero, with all our temporal travails becoming “Ghosts of departed Quantities” [Berkeley, 1992; 199]. In line with this, Grainville, despite his theistic scaffold, closes the narrative with the negativity of time’s final dissolution—yet does so *without* any recuperative visions of ensuing eternity or meaningfulness—duly frustrating the cosmological *Aufhebung* of traditional apocalypse, mutating its ‘sense of an ending’ into the ‘ending of sense’.

Nonetheless, Omegarus is early given his task of re-fructification by a mysterious figure: a *plutonic volcano deity*. First seen in a “whirlwind” of ejecta, he is “a man of himself forming that volcano by the torrents of fire that were impelled from his mouth” [i.38]. The figure calls himself the “Genius of the Earth” [i.50], who “presides over all [the planet’s] movements” and is “coeval with its existence” [i.41]. It is reported that his survival is bound to humanity’s survival, thus motivating his commanding of Omegarus to the misguided and immoral task of continuing the human race. This hypogene planet-dæmon becomes, thereby, the omnimalevolent driving force of Grainville’s narrative: fulfilling the typology of Satan.²² Clearly, as a demonic and hypogene will rebelling against God’s *ordinata*, this seismic spirit deeply resembles PBS’s Demogorgon.

Grainville’s “Genius” is a volcano, as is Demogorgon. Further parallel imagery and wordings are persistent: both are embodied as plumes of smoke [*PU*, II.iv.151]; both are described as emitting

²² He misleads and panders the pair toward procreating (for the selfish motivation of his own self-perpetuation) against the divine diktat of terrestrial extirpation. There are multiple Miltonic parallels throughout, cleverly inverting ‘first-times’ into ‘final-times’.

“gloomy light” [Grainville, 1806; i.38] or “rays of gloom” [PU, II.iv.3] from their eyes. Both live “at the centre of the earth” in “subterranean chambers”: it is here that Grainville’s Genius maintains “perpetual fires [to hold] back the deadly cold [advancing] to the centre of the world” [1806; ii.162-3]. This latter, of course, references the “gloomy theory” of Buffon, that PBS was fond of. Moreover, residing in “immense laboratory” underground, Grainville’s fumarole-deity plays terrestrial alchemy in a manner alike to Demogorgon’s own lair of Hadean potencies. Thus, even though images of “Earthquake’s Demon” and of alchemical “genii” in chthonic workshops, were somewhat conventional (cf. Martin [1792; iii.250], Parkinsion [1811; i.10], or Montgomery [1827; 16]) it is perhaps plausible that PBS had encountered Grainville’s narrative directly.

And, moreover, just like Grainville’s *dæmon*, the *central* narrative role of PBS’s Demogorgon concerns human extinction. In Act.III of *PU*, that is, Jupiter betrays Demogorgon’s original and intended purpose: the chthonic entity was *supposed* to “redescend and trample out the spark [of the] soul of man”; a spark remaining “unrepressed”, like “unextinguished fire”, yet “soon to fall”, Jove remarks [III.i.1-17]. Were this to happen, humanity would then join those previous species, “[j]ammed in the hard, black deep” [IV.302], toppled variously by “deluge” or “comet” [IV.314-8]. Thus, through Demogorgon (as the embodiment of geohistorical contingency), the ‘possibility space’ of *PU*’s chronotope can be said to include *human extinction* as accreditable plausibility.

Although this particular ‘possible world’ (i.e. the one in which humanity expires) does not become diegetically actual, it is nonetheless precisely that which lends PBS’s narrative the forcefulness and significance of its Promethean message by granting to it such pressing and absolute stakes. For, though ‘human extinction’ is indeed not portrayed ‘on-stage’, it is nonetheless *embedded subjunctively* within

the poem's implicatory space of plausibility (by way of Jove's comments on Demogorgon's power) as the grave 'fail-state' of the Promethean project. And it is precisely this dimension of *irrealis* implication (i.e. that the human "spark" *could* be trampled) that lends resonant hortatory force to PBS's radical message of social reform: *since we are responsible for ourselves, we humans must reason ever better, or (potentially) never again*. Put differently, autonomy's obverse is extinction. Nonetheless, PBS's imperative to enlightenment is ultimately no legitimate obligation at all: because, although it stumbles towards assenting totalized risk as essential adjunct to absolute self-culpability, it backslides again into exhaustive identification of justifications with existences—thus repealing its normative legitimacy—via retention of that old utopian hobbyhorse regarding the coincidence of world-progress and human-progress, by way, that is, of diegetically attempting a complete geophysical cancellation of risk. This is the natural result of his retention of foundationalist habits elsewhere (i.e. the geocosmic unconscious).

7—ERDREVOLUTION

In *QM*, PBS had written there is "no great extravagance in presuming that the progress of the perpendicularity of the poles may be as rapid as the progress of intellect; or that there should be a perfect identity between the moral and physical improvement of the human species" [2004; ii.255-6]. This flagrantly uncritical premise—projecting utopia only via *naturalising rationality*, or, collapsing any distinction between justificatory ends and natural causes in the name of eliminating fallibility and risk—was one that PBS stubbornly refused to abandon. This even despite his flirtation with newer paradigms that leave behind these naïve epistemological commitments (as we later see, it would be left to MWS to fully leave such commitments behind).

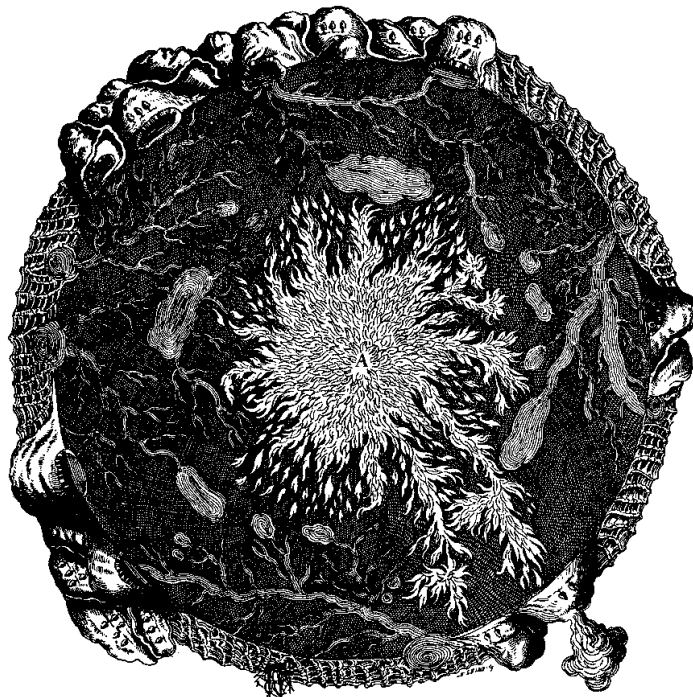
In similar tone to PBS’s declaration of “perfect identity”, Hegel’s *Geschichte der Philosophie* climaxes accordingly:

[i]nwardly opposed to itself, [*Geist*] is inwardly working ever forward (as when Hamlet says of the ghost of his father, “Well said, old mole! Canst thou work i’t’h’ground so fast?”) until grown strong in itself it bursts asunder the crust of the earth which divided it from the sun [so] that the earth crumbles away.

[1995; iii.547]

Hegel elsewhere wrote of Earth “perpetually kindled and stimulated by its *universal self*, the activity of *light*, its primordial relationship to the sun” [1970; 118-9].

From Pythagoras to Aristotle, through Copernicus to Nietzsche, the Earth-Sun relation has ubiquitously been modelled as one of kinship [Schrempp, 2011]. And kinship itself is a relation that can be understood as *mutual inclusions* (of ‘inheriting’ and ‘inherited’). Hence, the perennial tradition, from Empedocles [Gurthrie, 1962; i.289-293] to Burnet [1965; 266] to Leibniz [2008; 49], for positing within the earth a ‘central fire’ or “*ignis centralis*”—in Lucretius’s words, a “hot sun underground”



Kircher's “central fire” [1669]

[2007; 224].²³ This strong collocation between “terrestrial sun” and “foetal earth” [Barlow, 1838; 275] set the stage for a narrative of ‘natal return’ or ‘apocatastasis’: whereby our planet’s “subterraneous sun”, as Erasmus Darwin called it [1799; i.15], would, through luminary recrudescence, shed the material dross of its planetary crust, returning itself to primordial identity with its parent star. (Certainly, light is, for Hegel, just matter expressed as “*pure self-identity*” [1970; ii.13].) Where light is clearly the avatar of reason, this “old mole”—torqueing through the crust—will one day fully sublimate material recalcitrance and denude the “crust of the earth” entirely. (World-spirit as subterrene; enlightenment as *regressues ad solem*.) Hegel deploys this metaphor of ‘crustal moulting’ to communicate his confidence in humanity’s eventual victory over unruly nature. PBS used the image similarly:

The earth doth like a snake renew
Her winter weeds outworn

[‘Hellas’, ll.3-4]

Crustal exuviation instantiates completed utopia. In PBS’s *PU*, this is exactly what happens. Appropriately, the mechanism for this is the achievement of the aforementioned orbital accord.²⁴ Following this, *the earth becomes sun again*.

Earth’s orbit—once a “wheel of pain” [I.141]—becomes the “thousand sightless axles spinning” [IV.248] of this central image of Act.IV. The celestial equator is “perpendicular now” [IV.277], thus

²³ Descartes first classified the earth an encrusted aborted star [1991; 181]. Leibniz “amused himself by making the earth an extinct sun” (as Cuvier later quipped) [2008; 200]. Kircher and Burnet promoted the idea. It gained further traction in eighteenth century France [Newcomb, 2009; 138]: where Buffon & Bailly employed it as motor behind their geohistories, and Mairan [1765] endeavored to prove it mathematically.

²⁴ Hegel, suitably, had evidenced his idea of Earth-Sun kinship via the effects of ecliptic angle on terrestrial seasons [1970; 118-9].

provoking the *musica universalis* to renew, as tellus’s denizens hear “the deep music of the rolling world” restart [IV.186]. The planet’s “hours” are transformed from “wingless, crawling” prisoners [I.48] to beings “free [to] soar” [IV.137], and thus, “outspeeding the night”, they render a “world of perfect light” [IV.167-8]. What’s more, the planet-girdling atmosphere, concordantly becomes “impalpable thin”: inaugurating new photometric conditions that allow vision to ‘distend’, unassisted, outward into the “mysteries of the Universe” [III.iv.100-105]. This unobstructed vision appears to be fundamentally extramissive, however: for, just like Hegel’s “old mole”, *Earth peels forth with inner-light*. “Darting from starry depths radiance and life, doth move” [IV.387]; penetrating the “abyss with sunlike lightnings”; such that “Heaven and Earth [are] united now” [IV.274-6]. “[B]eneath, around, within, above” [IV.353], tellus itself

shinest
With a light which is divinest
Among all the lamps of Heaven

[IV.459-61]

With this, Earth’s inorganic mass, returning to ‘solar-logos’, subtilizes into a balloon of flaming *nous*. *Henosis* is achieved between upper and lower: “in the deep there lay” incandescence “as in a sky” [III.iv.82-3]. Refulgent rays “[p]ierce the dark soil”, climaxing with Panthea’s witness to the fossil-record revealing itself in its complete entirety, as the glowing core makes “bare the secrets of the Earth’s deep heart” [IV.278-9]. From archaeological “trophies” through palaeontology’s “uncouth skeletons” [IV.293-299], geohistory exhumes itself, surrendering itself for human comprehension. Consequently, what was once entirely irrecoverable, and, as an embodiment of that which is indivisibly unjustifiable in nature, acted as the prime symbol for existence’s non-responsivity and autonomy *vis-à-vis* our rational framework—or, in other words, acted as the very emblem of *unpredictability itself*—is here

—from thine inorganic voice—

vanquished by phosphorescent revelation. This consummates PBS's millenarian repatriation of rationality within the cosmos: a return of dwellers to dwelling.

The planet, that is, recoups perfect identity between justifications and existences by egesting the redounding *unjustifiability* of palaeontology's irrecuperable saltations and irreversible extinctions, duly subtilizing the lithosphere into a noösphere. (The 'inorganic' becomes 'inorganical'). How? The Earth, quite simply, becomes transparent:

A sphere, which is as many thousand spheres,
Solid as chrystal, yet through all its mass
Flow, as through empty space, music and light:
Ten thousand orbs involving and involved,
[...]
Sphere within sphere, and every space between
Peopled with unimaginable shapes

[IV.238-44]

Exchanging abiotic inhospitality for “glassy essence”, this—as the culmination of his masterwork—is PBS's “intertranspicuous” utopian Earth.

As Reisner [1974] established, PBS's ensuing description of the dynamic globe's “self-conflicting speed” [IV.259] clearly alludes to contemporary celestial mechanics, notably Euler's orbital computations. Ergo, the irreducible contingency of Cuvierian palaeontology is ultimately swapped out for the perfect predictability of Newtonian physics. Earthquake-Dæmon is replaced with Laplace's Dæmon. As should be clear, PBS is here attempting the *total cancellation of risk*: where ‘risk’, as we establish in the next chapter, is nothing other than our cognitive ability to track our own ignorance and, thus, lack of infallible foundations in knowledge. And, by consequence, said cancellation is nothing other than a return to the ‘safety’ and ‘security’ of foundationalist world-models. This is borne out perfectly in the fact that another key source (thus far unnoticed) for PBS's “multitudinous orb” [IV.250]

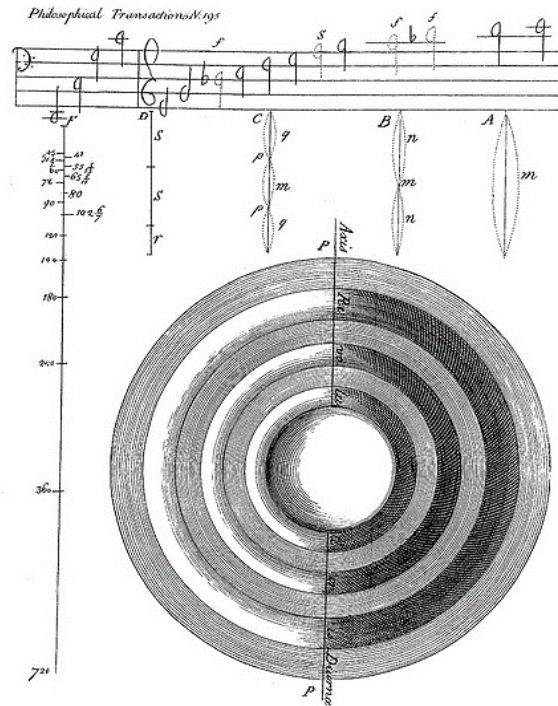
is that of the *hollow earth*, which, as a physical theory, is itself nothing but the reinstatement of concentric belongings.

8—HOLLOW EARTH

Euler’s computations of our spinning globe’s ‘self-cancelling’ kinematics were intended to account for orbital irregularities and ensuing polar oscillations. Nearly two centuries earlier, Edmond Halley [1683] had grappled the related issue of nutation of Earth’s geomagnetic poles and, in response, had formulated an ingeniously outlandish solution [1692]. To account for these periodic shifts, his answer (dimly foreshadowing modern ‘dynamo theory’) was to model the Earth as *hollow* and *filled with concentric shells*, each rotating separately and with their own magnetic-poles: the “self-conflicting” motions of which aggregate, Halley hypothesized, into the regular oscillations observed in Earth’s magnetic field. Writing from an age still enamoured with plenitude, Halley anticipated a prime objection to this “Romantick” conjecture [1692; 564-5]: it opens an equator-spanning chasm in the ontological ligature of judiciary. Given that (within plenitude’s worldview) existence *just is* its justification, why would an “inward” world exist “*uninhabitate*” and “*sunless*”? Halley responded not only by populating the entire planet—*ad inferos*—down through all its staggered layers; he also decreed that the entire inner-space would be populated by “Luminaries” and “Concave” surfaces coruscating with phosphorescence like “the Sun” [576].

One cannot help but point out that, aside from populating each layer with “intertranspicuous” light, PBS, similarly, stresses that—“[s]phere within sphere”—each concentricity of his globe is “[p]eopled”. *Just like Halley’s*. Certainly, the idea of the ‘Hollow Earth’ had remained visible and alive in the interim

—from thine inorganic voice—



Halley's hollow earth [1692; 578]

between Halley's original theorisation and PBS's time [Fitting, 2004]. Cuvier [2008; 202], Humboldt [1848; i.163-4] and Whewell [1839; 50] all deemed the theory, outlandish though it is, worthy of treatment in their retrospects of geothery. Moreover, all the way from Cotton Mather [1721; 109] to Sir John Leslie [1829; 449-53], naturalists continued to seriously endorse the idea. (The latter, a translator of Buffon, reasoned that, unless the earth-interior was largely void, the density of matter at the core would be physically infeasible; thus, it must be hollow, yet, since "absolute void is inadmissible", this "vast subterranean cavity must be filled with some diffusive medium [of] astonishing [...] repulsion"; Leslie duly elected luminescence for the job, theorising an ongoing explosive emanation of inner "LIGHT".) Late entertained by scientists, the conjecture was inevitably seized upon by the utopian imaginary, becoming setting for fantastic narratives. And the entrance to this 'world-within' was, suitably, often located at the symbolically-loaded poles (PBS and MWS, of

course, being no strangers to ‘Polar Romance’) [Wilson, 2002 & Nelson, 2001; 139-188].²⁵ Many ‘hollow earth utopias’ were written—with even Casanova penning one [1787]—but by far the most influential was Ludwig Holberg’s massively popular *Niels Klim’s Underground Travels* [1741].²⁶ Not only does Klim’s underground world depict civilized inner-convexities and illuminated inner-concavities (much like PBS’s “intertranspicuous” geocosm), but we know that PBS discussed such utopias with Jane Williams as early as 1814 [Holmes, 2005; 258], and, more importantly, MWS read Holberg’s book (lately republished in English) the year before PBS began composing *PU* [Shelley, 1987; i.157 & Goodall, 2008; 23]. PBS, in other words, was unquestionably familiar with hollow earth topoi. Nonetheless, what is crucial here is the *symbolic function* of the idea. Exemplifying what Nelson calls a ‘psychotopography’ [2001; 110], the attraction of the ‘hollow earth’—as symbolic form—is the cosmographic return of exhaustive *ab ovo* self-containment. The reinstating, that is, of the lost baroque world-physics of Leibnizian staggered inclusivities. (Platthaus writes of the hollow earth that ‘the best of all possible worlds is still a closed one, and if this closure can no longer be claimed for external space, it can at least be reconstructed in an intensified inwardness’ [2012; 37-8].) Hence, the jubilant recuperation, in PBS’s master-image of the “multitudinous orb”, of the physics of interminable belonging: a re-activation of *QM*’s chronotope of “involving and involved” immensity. And this, in turn, codes for a cancellation of *global risk*. ‘Closure’, that is, is not only spatial but, integrally, modal in scope: amniotic physics caches out as the security of an ‘existential insurance policy’. Therefore, just as

²⁵ Due to recession of *terrae incognitae* in step with global circumnavigations, the ‘utopic horizon’—insofar as ‘utopia’ is a hypostasis of the capaciousness of ‘the unknown’—receded towards the *axis mundi* and, given polar encroachments, eventually imploded down inside.

²⁶ Going through ≈34 editions, *Klim* was translated widely; De Quincey embarked upon a translation [1953]; Wordsworth’s *Prelude* references its ubiquity [Havens, 1941; 536].

PBS seems to flirt with the new-fangled sensitivity to ultimate risk—in order to lend force to his Promethean exhortation—he, ultimately, reneges on it and sublimates its plausibility.

9—CONCLUSION

PU's “multitudinous orb” is PBS's ‘best possible world’, and he mortgages its actualization to a speculative suite of geodynamic processes (the precession of the equinoxes alongside Hutton's cycles plutonic recontexture). Yet, where PBS thusly manacles his Promethean utopia to an ultimately arational causative ‘geodynamo’—committing himself to a naturalistic fallacy via uncritically mingling *causes* and *reasons*, or, *existences* and *justifications*—he abrogates its legitimacy of a fully autonomous ‘kingdom of ends’. Unwilling to accept the globalizing stakes of extinction, he fumbles the global self-legislation demanded of true emancipation. Like Kant's Hume, he runs the “ship ashore, for safety's sake”.

We do not ‘inherit’ our “*Wohnplatz*”, much less inherit it from blind volcanic cycles—*we must manufacture it ourselves*. Ergo, despite dabbling with irreversible extirpation as motivating narrative counterfactual, PBS's quasi-Schellingian *physics of the unconscious* ultimately overpowers any coherent self-assertion of reason's Promethean project (alongside its attendant riskiness): thought is maximally ensconced within *being*—even if unconsciously or opaquely so by way of ‘upstream irrecoverability’—such that it still cannot *not be*. This is narratively consummated via PBS's georevolutionary cancellation of riskiness. Thus, PBS miscarries his rational utopia precisely in the act of attempting (overzealously) to insulate it from its own precarities. That is, his attempt to domesticate and sublimate nature's loss of inherent hospitality via imbuing it with an “inorganic voice” and planetary preconscious is *essentially irrational*, in that it can secure for PBS his projection of reason and nature's future unification solely by

way of an essentially irrational geodynamic motor reliant on blind plenitude (the earth-machine, in course of deep time, *must eventually* express a ‘best possible world’). Rationality cannot *navigate*, it must *await* (essentially, this is “*amor fati*”). Neutered of the insecurity attendant upon both true riskiness and true autonomy, cognition’s Promethean project is, ironically, manacled once again the foundationalist ‘authority’ of brute, factitious, exigent existence. The lesson to take away here is that Romantic idealism, *as much as* its Leibnizian forebear, is (despite flirtations with nature’s contingency and inorganicity) still incapable of licensing the full-scale implications of ‘human extinction’: because submitting reason to maximally mindless being (via an unconscious “groundless ground”) is just as foundationalist as instead subordinating being to maximally jurisprudential reason, and both remain permutations of pleroma (i.e. aboriginal identification) and, thereby, are alike forms of amniotic closure (even if the former attempts to occlude this). Plenitude persists long past its explicitly theodical permutation, and is easily retrofitted onto nature’s blind drives and unconscious becomings: for, whether conceived in light of the former or latter, it universally reduces all modal locutions to nonmodal correspondences, and, thus, jettisons the language by which we stake out meaningful distinctions between conceptual and non-conceptual spheres, and, therefore, it is, across all its permutations, thoroughly foundationalist. (We clarify these claims across coming chapters.) The ‘manacles’ of brute existence’s mindless maximality—even if no longer divinely ordained or jurisprudential—remain a tempting type of cradle. Thus, though providing ‘ground zero’ for popular engagement with the idea of ‘X-risk’, the Romantics were not the ultimate tributary for the idea’s articulation.

Filling palaeontology’s gaps of contingency with a pleroma of populated light, the hollow earth is the most ostentatious denial of geohistorical risk imaginable. The trigger for such ostentatiousness, of

—from thine inorganic voice—

course, was the fact that extinction was, contemporaneously, becoming ever more feasible, ever more pressing, ever more explicated. To this we turn, to account for the *intellectual discovery of X-risk*.

‘HERE, THEN, IS A VERY RATIONAL END OF THE WORLD’: the INTELLECTUAL DISCOVERY of EXISTENTIAL RISK

There is nothing properly dead in the world; that only is dead which is not, only the nothing.

The sun can never be extinguished, never become dark.

—Lorenz Oken

Man's *death*
Inhabits all things, but the thought of man.

—Edward Young

0—INTRODUCTION

Future-oriented propositions upon X-risks and human extinction scenarios emerged during the eighteenth century. As we establish in this chapter, this emergence cannot be accounted for solely by way of extrapolations from previous extinction events (which, indeed, only first came to be understood in the period), though this is nonetheless a crucial context. We will see that the inception of ‘X-risk sensitivity’ is *not* straightforwardly a question of abstracting from empirical data, but *necessarily* also a question of elaborating core aspects of our theoretical framework upon all such data. This being because any postulation upon the prospective closure of reason covertly involves reasoning upon the propriety of reasoning itself, inasmuch as we first needed to become aware of the fact that nature does not itself have a *necessarily* rational and value-laden structure (such that the existence of these latter items can first become acknowledged as precarious). (We explore the philosophical genealogy of this realization fully in Chapter 4.) Nonetheless, insofar as such ‘meta-descriptive’ elaboration provides sufficient

—here, then, is a very rational end of the world—

conditions for articulating our precarity, ‘X-risk’ remains an empty and inert proposition until *additionally* gaining properly descriptive (i.e. empirical) range and scope: such necessary ‘objective content’ came from the empirical-level vocabularies of natural science. In other words, one can theoretically articulate the universe’s lack of inherent rationality, yet only after one has gained further grasp of empirical matters relating to demographic science, probabilism, and physics can one fully explicate ‘existential risk’ in the sense that we understand it today (though there is, indeed, a relevant sense in which these two layers of inquiry are inseparable). In this chapter, having first tended to the fate of plenitude and explored the issue of the empirical data concerning previous extirpations, we delineate the emergence of these requisite objective vocabularies. These include, in order of treatment, 1) development of political arithmetic 2) a mathematized grasp of risk 3) comprehension of irreversibility in physics.

1—A BUBBLE BURST, 1834

In 1634’s *Comus*, Milton envisioned Earth’s subsurface fecundity—defining it by its severance from all surface-level justification—whilst hypothesizing a scenario wherein

unsought diamonds
Would so emblaze the forehead of the deep,
And so bestud with stars, that they below
Would grow inured to light, and come at last
To gaze upon the sun with shameless brows.

[ll.731-5]

From within his seventeenth century worldview of exhaustive plenitude and cosmic jurisprudence, Milton warns, *ex hypothesi*, that if this were to be so, then nature would become “waste fertility” and “self-fed” squander. The poet here inverts the imagery surrounding Earth’s “central fire”: twisting it

from inner-plenty toward plutonic-exorbitance and tipping subterrestrial resplendence into useless expenditure.

Despite Milton's conjecture dramatizing the possibility of nature's threatening and dangerous extrajudiciality, this imagery clearly echoes PBS's own utopian and idealized "starry depths". Indeed, PBS allotted the source of his Earth-Spirit's subterrestrial refulgence as none other than a "star upon its forehead" [*PU*, IV.270]. Therefore, whether intentional or not, a source for PBS's utopian earth was evidently *Comus*'s underground wastefulness (wherein "unsought diamonds" identically bestud "the forehead of the deep"). Extinction, it appears, is not so easily sublated: for, in this unlikely Miltonic source, PBS's master-image betrays the threatening reversibility of 'bounteous plenitude' and 'prodigal waste'.

Indeed, though *PU*'s mythos presents world-history moving beyond the threshold of catastrophism, it is simultaneously forecast that Demogorgon may once again "free" the "spells" of paroxysm, and "reassume / An empire o'er the disentangled Doom" [IV.566-9]. Demogorgon himself gets these last words of the drama: remaining, to the end, a "mighty power" [IV.510] to whom the Earth itself is a mere "drop of dew that dies!" [IV.523].

PBS's 'Ode to Heaven', published alongside *PU*, similarly envisions collective human consciousness as "a globe of dew" in which "are furled" the reflections of "[c]onstellated suns unshaken" and "[o]rbits measureless"; yet, despite comprehending such immensities, this "frail and fading sphere" is liable to "tremble, gleam, and disappear!" [ll.46-54]. (In order to clarify that he is, indeed, referring to humanity as a collective whole, PBS details of this "sphere" that "ten millions" are "gathered there"; and, as Roberts explains [1997; 116], "millions" is used 'almost exclusively' within PBS's idiolect to designate

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human populations at scale.) Thus, PBS’s metaphor—depicting an entire cosmos contracted into a precarious dewdrop’s reflection—serves to pinpoint an interesting conceptual feature of extinction: for expressing extinction puts into relief the *ideality* of all human valuations precisely by acknowledging the unchanging *reality* of the universe after them and in their absence.

And yet, postulating (even counterfactually) a universe stripped of all inherent value is precisely impossible assuming the plenitudinarian framework. This, however, is why the plenistic *Weltanshaaung* necessarily senesced from within. In other words, assuming plenitude to be true, it is the case that when factual existence becomes detached from all rational justification—as, indeed, was happening due to mounting evidences from empirical sciences regarding nature’s independence from such constraints—cosmic existence becomes recast as malignant wastefulness to *the very extent that it simply is*. Hence, the fatal reversibility of ‘pleroma’ and ‘prodigality’ is put into play (as a kind of self-obsolescing of plenitude). And this, indeed, is how the newfound sense of the precarity of rational values within the cosmos was first widely received and expressed.¹

October, 1834: *Fraser’s Magazine* publishes an anonymous poetic fragment entitled ‘THE VISION OF ANNIHILATION’ [anon., 1834; 439-42]. It depicts a universe wherein the “doctrines [of] atheism” are “true and real”. Implicitly presented, therefore, as a counterfactual conditional, the piece conducts itself as a thought experiment. Certainly, although the piece does not represent an ‘extinction event’ proper (occupying instead a thoroughly apocalyptic imaginary) it succinctly pinpoints the self-abnegation of these frameworks from within. The fragment itself, a dream vision, depicts a kneeling corpse praying

¹ This examples what Halmi [2007; 115], by way of Blumenberg, calls the ‘reoccupation of a conceptual system’ with ‘new content’: the ‘original content might condition but cannot survive this process’.

to nothingness, in a ruined church at the end of time. Belatedly answering the prayer, Christ descends. He is asked “Is there no God?” by a congregation of the damned, upon which Jesus decrees “THERE IS NONE!”. Jesus has scoured the universe—overturning “each bright galaxy”—but has only found “everlasting Desolation” in divinity’s place.

Interestingly, the editors insist on the vision being “worthy of the genuine inspiration of Byron or of Shelley”: the piece’s terza rima was, it is reported, “chosen in imitation of Shelley’s [...] *The Triumph of Life*, which the present poem resembles in other respects”. ‘Shelleyan’ though it may be, the piece is actually a loose adaptation of J.P.F. Richter’s prose piece, ‘Rede des toten Christus’ (‘Speech of the Dead Christ’), originally published in his *Siebenkäs* of 1796-7. Exported from Richter’s native German into France through de Staël’s 1810 *De L’Allemagne* and rendered first into English via F. Hodgson’s 1813 translation of the latter, Richter’s ‘Rede’—after leaving a mark on both the work of Coleridge and De Quincey—was again translated anonymously for *The Athenaeum* in 1829, and again by Carlyle in 1830, before continuing to inspire imitations well into the 1840s [Vijn, 1982]. The poetic version at hand, from 1834, is one of the more creative adaptations; all are alike, however, in playing out the obsolescence of plenitudinarianism from within its own framework.

In the *Fraser*’s rendition, Jesus laments that, from the vantage of his interstellar search, all he detects is

Tears trickling from the Rainbow of Creation,
Without a parent sun, that gleaming hung
Above the Abyss—the dark Gulph of Negation.

[1834; 440]

“[A]ll was void”, we learn. In Richter’s original, similarly, Christ is left directing his plaintive orison to “Mute, inanimate Nothing!” [1992a; 182]. Again, from within plenitude’s framework, since being *just*

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is its justification, should the cosmos lose this jurisprudential support, the universe itself becomes precisely indistinguishable from exorbitant nonbeing. Of course, here, the loss of this support is figured as the loss of ‘God’:

when I looked up to the immeasurable world for the Divine *Eye*, it glared on
me with an empty, black, bottomless *Eye-socket*.

[Carlyle, 1982a; 234]

The absolute, no longer vital nor noetic, is now inorganic and unresponsive: a cosmic rictus. Richter’s original, indeed, stresses that “the All” has turned abiotic: a “great stony” monument; a “cold iron mask”; the universe is now a “vast sepulchre” [1992a; 180-2]. Pope’s “stupendous whole”, for which “God [is] the soul” [2016; 24], has here become, as Richter puts it, “Nature’s dead body, which no universal spirit moves and contains” [1992a; 180]. (Note the loss of ‘*containment*’.) And so, the ‘death of classical metaphysics’ (meaning the senescence of pre-critical systems of ‘belonging’ naïvely presuming being rationalistic in structure) is here inchoately and incipiently vocalized as a ‘metaphysics of death’ (i.e. not just the negation of divine foundations, but the divination of their negation, by way of the dramatized possibility of an ‘inorganic absolute’). In the *Fraser*’s version, Jesus exclaims

When for the Eye Divine I upwards flung
These orbs of light, the immeasurable world
Glared back, nor spoke its inorganic tongue.

[1834; 440]

PBS, it seems, inspired more than the piece’s rhyme scheme. We recall *PU*’s “inorganic voice” (written fourteen years prior) being the first usage of “inorganic” in verse. This may well be the second. Yet, where PBS’s image had sought to vouchsafe therapeutic and indwelling reciprocity between cognition and the cosmos (even if absconded and unconscious), the “inorganic tongue” displayed here implicates nature’s responsiveness to our intuition only under the sign of its conspicuous retraction (i.e. nature’s

stony silence, or, recalcitrant refusal of dialogic response). “Religion”, PBS had written in *Queen Mab*’s notes,

is the perception of the relation in which we stand to the principle of the universe. But if the principle of the universe be not an organic being, the model and prototype of man, the relation between it and human beings are absolutely none.
[2004; ii.261]

Appropriately, Richter’s *Dead Christ* concludes thusly:

We are all orphans,—I and thou, alas!
[anon., 1834; 441]

Looking down upon “the grinding press of worlds”, Jesus subsequently witnesses “how world after world shook off its glimmering souls, upon the Sea of Death, as a water-bubble scatters swimming lights on the waves” [Richter, 1992a; 182]. Again, entire populations imaged as fragile dewdrops. The source of this image, within both PBS and Richter, is, of course, Pope, who, exactly a century prior in 1734, wrote, in the triumphalist mode of the Enlightenment sublime, of the cosmos’s awe-inspiring cycle of destruction and renovation:

And now a bubble burst, and now a world
[2016; 12]

Where this comparison had once served to express the utmost security of reason within the cosmos (by way of implying how, given that the universe is *maximally* populated, an obliterated world is a triviality), it later came to express the very failure and collapse of this very metaphysical insurance system (showing the universe to be profligate beyond recompense and comprehension). Indeed, the very same year the *Fraser*’s piece was published, conservative theologian Edward Nares published a treatise on geology and scripture. Therein, whilst discussing Christianity’s promise of millennium,

Nares suddenly interdicts, jubilating that “Here then is no extinction for us” [1834; 240]. The mere fact Nares felt it necessary to clarify this speaks volumes about what had taken place across the prior century.

2—THEORY-CONTAMINATION, 1796

Where did awareness of ‘human extinction’ come from? A low-hanging explanation is presuming a straightforward case of *induction* from emerging scientific acceptance of prior species extinctions to our own future senescence. Of accounts that do acknowledge ‘human extinction’ as a conceptual development during the period, there is a tendency to do exactly this: for, even if not entirely explicit, most accounts simply cite Cuvier’s pathbreaking 1796 paper upon prior extirpations by way of sole explanatory or contextualizing touchstone.² The 1796 paper in question saw Cuvier provide ‘irrefutable’ empirical evidence ‘for the reality of extinction’ concerning prehistoric biota via an application of comparative anatomy to fossil bones (mammoth molars, to be precise) [Rudwick, 2008; 101]. This led to scientific consensus upon the previously contentious issue of whether species could disappear.

Appeals to exclusively and nakedly inductive sources for incipient articulation of our *own* species’ precarity can be demonstrated to be misled solely by pointing to the deeply *theory-laden* nature of Cuvier’s own empirical practice in proving prior extirpations. The Baron’s observations on fossil bones—and thus also his conclusions concerning prehistoric fauna—are, in other words, inextricably mediated by theoretical inferences involving entirely unobserved and unobservable premises. (We derive ‘theory-laden’ from Hanson [1965] and Kuhn [1962]. The basic idea, however, in fact dates to

² E.g. Bailes [2015], Redfield [2013], Herringman [2004; 72-4], Mayer [2013; 5], Cameron [2016; 263], and Allen [2008; 103].

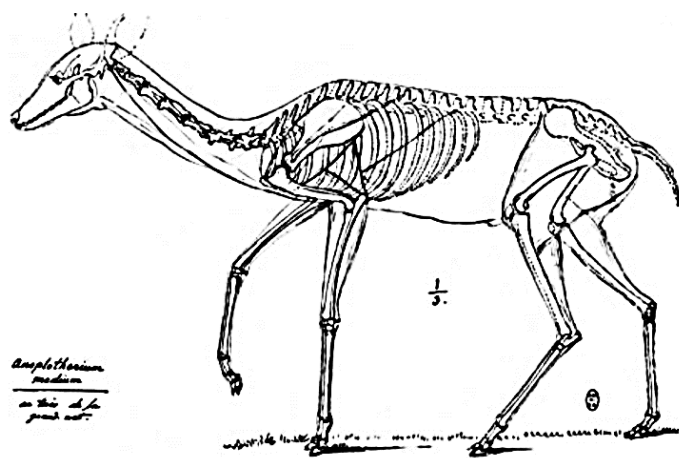
the period. William Whewell noticed that *all* empirical perceptions involve “unconscious inferences” of a theoretical nature [1858; i.43-6]. For example, the eye “sees length and breadth, but no third dimension”; therefore, in “order to know that there are solids, we must infer as well as see”; this activity becomes so well-worn, Whewell argued, that we are barely aware of it [1858; i.112].) Despite his own injunction that geology should be “as positive as any other observational science” (which was largely just tactical posturing against “hypothetical” extravagances of prior physico-theologies) [2008; 125], Cuvier’s pioneering methodology (of reconstructing extinct fauna from incomplete osteological evidences) is a uniquely cogent example of theory-contamination in empirical observations.

From antiquity to the seventeenth and eighteenth centuries, wild ignorance about fossils prevailed; they were encountered not as organic remains but as nonorganic products of “mineral virtue” or “*lusus naturae*” [Rudwick, 1972]; nowadays, however, even children can securely infer from incomplete palaeontological remains to an imagined organism. This is testament to the inextricably theoretical web-of-belief tacitly buttressing any observation of petrified matter *as* impressions of prehistoric fauna. Cuvier, importantly, was the first to codify such reconstruction as scientific practice.³ Indeed, illustrations of reassembled fauna—based upon incomplete fossil anatomies—presented an entirely novel conception. (Jean-Bautista Bru’s osteological re-assembling of *Megatherium* bones into a reconstructed skeleton ‘was probably [first] of its kind’ [Rudwick, 1992; 31-2], but Cuvier pioneered and normalized the reconstruction and illustration of soft-body anatomies vividly representing never-before-seen organisms as if they were alive within their prehistoric environments. Reassembling “forms

³ Balzac betrays contemporary perceptions of the novelty of such feats of reasoning, marveling at how this “immortal naturalist has reconstructed past worlds from a few bleached bones” [1901; 21].

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of muscles” from “bones and their ridges” and thence covering it with “skin”, one consequently models for oneself “not only the skeleton that exists but [the] entire animal as it existed in the past” [2008; 40]. He had first talked of doing this, in the mind’s eye, in 1800; by 1804 he had detailed this procedure rigorously and illustrated some osteological examples; he failed to ever publish, however, the ‘superb drawings’ he produced depicting ‘the inferred soft [anatomy] of several species’ [Rudwick, 2008; 61-2].)



Cuvier's soft-body reconstructions [Rudwick, 2008; 66]

Organisms are themselves ‘holistic’—constitutively so—which is why the cognitive operation of anatomically reconstructing them is in itself so exemplary of the *epistemic holism* of ‘observation’ and ‘theory’ within any such inquiry: in other words, one must have a theoretical ‘model’ of the absent anatomical whole in mind before making sense of any of its scattered, yet empirically available, parts.⁴ More so, as already ventured, even the basic capacity to encounter lithified zoomorphic fragments as organic remains of no-longer-extant fauna was, in itself, an achievement attendant upon a whole

⁴ Cuvier: “Each part in turn is in a necessary relation with all the others, such that up to a certain point one can infer the ensemble from any one of them, and vice versa” [2008; 50].

network of inferences about unobservable events and auxiliary hypotheses (hard-won theoretical presuppositions regarding, *inter alia*, ‘deep time’, ‘organic mutability’, ‘nature’s historicity’, etc.). Simply put, any such ‘observation’ implicitly yet unavoidably relies upon conditionals—of the counterfactual form ‘if *X* was alive, then it would look *Y*’—notoriously hard to reduce to merely descriptive or empirical vocabularies. Cognizant of this, Cuvier himself referred to nimble “leaps of imagination” required in anatomical resurrection [2008; 88] (an aspect not unnoticed by his peers, with one noting during Cuvier’s Paris lectures that the palaeontologist “had made [an entire] world in his [mind]” and had reproduced entire “[mountain] ranges” mentally [2008; 40]). Certainly, the Baron could (and infamously did, with ‘showman’s flair’ [Kolbert, 2014; 34-5]) make his inferences from jumbled petrifications to fully-fledged biota *look like* pure and isolated intuitions (“*give me the bone, and I will describe the animal!*” [cf. Dawson, 2016]) and yet the spontaneity of this competency was imbricated throughout by this tacit theoretic backdrop (i.e. Whewell’s “unconscious inferences”). Rudwick unveils that Cuvier often betrays this ‘backdrop’ by noting that ‘his conception of “facts” in science’ was far subtler ‘than that word in its modern usage might suggest’ [2008; 174]; for, fond of chirographic metaphor, Cuvier remarked fossilific “facts” are “imprinted everywhere, for the eye that knows how to read history in their monuments” [2008; 190]; and so, just as all acts of immediate textual comprehension are mediated by mastery of a wider grammar, “facts” in palaeontology are not isolated observations but are, ineliminably, implicated with unobservable theorizations.⁵ (Thus, why Italian

⁵ Hieroglyphic and antiquarian metaphors—traceable at least to De Luc [Rudwick, 2005; 234]—were common, acting as *semantic crutch* in this nascent stage of the apprehension of nature’s historicity. In the expressive incipience of such vocabularies, metaphor serves as ‘crutch’ to fill in for expressive imprecision and terminological inchoateness. As Emerson noted, “language is fossil poetry” [1990; 205].

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geologist Scipione Breislak remarked “[i]n geology we cannot dispense with conjectures” [1811; i.81], or, why Buffon remarked the “best crucible is the mind” [Roger, 1997; 393].)

Consequently, insofar as ‘inducing’ prior extinctions is hereby necessarily theory-intricated, ‘inducing’ future human extinction is, *a fortiori*, likewise downstream of a thoroughly theoretically-inflected web-of-belief. Thus, it was not reached via isolable induction, but, instead, was ‘colligated’ from—and, thus, dependent upon—a constellation of prior conceptual competencies. Of course, the first (and most obvious) of these ‘competences’ regards the framework-shifts in fields of biology and natural history that, in themselves, enabled Cuvier’s pathbreaking 1796 paper.

Before we explore this biological context and the emergence of other necessary areas of science, we note (in preparation for later explorations) that the ‘theoretical’ nature of this background is not in any way trivial. For the uniqueness of science (over above our ‘manifest image’ of the world) lies in its postulation of ‘theoretical objects’ or ‘imperceptible entities’ in order to ‘explain the behaviour of perceptible things’ [Sellars, 1963; 43]. Postulating theoretical entities, moreover, involves implicit acknowledgement that human experience (i.e. our ‘forms of intuition’) doesn’t exhaust independent reality, which, in turn, involves prior reflections upon the corrigibility of human cognition itself, which, indeed, is *nothing but* sensitization to the precarity of cognitive activities as such. This, again, is what (genealogically) distinguishes ‘extinction’ from ‘mythology’: just like science’s theoretical entities, it is essential to extinction’s unique expressive role that it be postulated as *unobservable* and that it be fully self-conscious of this stipulation (as opposed, that is, to articulating some mythical object assumed as observable yet merely, thus far, *unobserved*). And so, as thus identifiably keyed into science’s operation and logic, we now explore the specifically scientific tributaries requisite for extinction’s expression.

3—NONHUMAN EXTINCTIONS, 1660-1800

There exists a rich history of discussions regarding extinct species *long before* Cuvier. Most scholarship ignores this.⁶ Eiseley embodies this stance by claiming that ‘man had passed’, in ‘scarcely more than a generation’, from staunch conviction in nature’s ‘great chain of being’ all the way to full-scale acceptance of species mutability [1999; 49]. Rehbock noted this is the ‘traditional interpretation’ [1985; 134]. Contrarily, we note (alongside Rudwick [2008; 17], Carpi & Egger [2011; 50], and O’Connor [2007; 64]) that ‘the phenomenon of extinction had been widely accepted by many European naturalists’ decades prior [Rowland, 2009; 235]. Tucker Jones insists that historians have wrongfully ‘not credited eighteenth- and early-nineteenth-century natural historians with understanding the significance of extinction’ [2014; 3]. ‘Extinction was an old problem’, enjoins Stewart Thomson, ‘Cuvier had simply made the question one of greater immediacy’ [2008; 59].

Already in the 1740s, Maupertuis [1742; 24-6] and Diderot [1749; 123] had accepted species mutability: the former wrote that “the species which we see today are but a small part of those [originally] produced”. By 1755, Buffon confidently opined that “[species] must die out, because Time fights against them” [1749-88; v.62]. During the 1760s, William Hunter had used incipient comparative anatomical methods to prove the so-called ‘*Ohio incognitum*’ (a Mastodon uncovered three decades prior) evidenced an organism no longer extant. He later did the same for the Great Irish Elk [Rolfe, 1985]. By this time, the French *philosophes* appear to have fully accepted extirpated species, with Voltaire inveighing that any uninterrupted “gradation [of] species” cannot “exist any longer” because

⁶ E.g. Archibald [2011; 56], Courtillot [1999; 4-5], Ellis [2004; 9-14], Taylor [2004; 3], and Cotner [2011; 63].

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innumerable “species [are] totally extinguished” [1765; 86-7]. “Where, then, is the chain?”, he challenged. The German naturalist Petrus Camper (whom Kant cited concerning his “*Naturrevolution*” [1799; 161]) turned his attention to the extinct woolly rhino during the 1770s, thereafter drafting an unpublished paper on extinct quadrupeds [Meijer, 1999; 63-6 & Rudwick, 2005; 274-5]. Around this time, d’Holbach provocatively asked whether “these animals” are so “indispensably necessary to Nature” that “she cannot continue” without them [1795-6; i.149]. In 1774, Oliver Goldsmith’s *Animated Nature* relayed Buffon’s opinions on extinct Siberian mammoths to a popular English audience [Semonin, 2009; 158-61]. Cuvier’s previous tutor, C.A.F. Kielmeyer, dwelt, in an influential 1793 paper, upon the fact “species” have “frequently” senesced [1993; 42-44]. And, just two years prior to Cuvier’s 1796 paper, the first binomial classification had already been given to an extinct species: with speleologist and neuroanatomist Johann Christian Rosenmüller presenting a study on a prehistoric cave-bear, nomenclating it *Ursus spelaeus* [Rosendahl, 2005].

Mayor has shown the Greeks and Romans cognizant of fossils—some even stumbling towards ideas of organic origination—yet they explained them mythologically [2000; 210-27].⁷ Parejko [2003] has recently demonstrated that Pliny the Elder’s AD 77 *Natural History* records the anthropogenic extermination of the *Silphium* (a popular contraceptive); this observation, however, was not ‘absorbed into the body of Western thought’, along with other human-caused extirpations potentially acknowledged by the Roman naturalist [Turvey & Cheke, 2008; 150]. However, noting ongoing depletion of herbs is entirely distinct from abducting prehistoric extinctions. Indeed, this idea ‘did not

⁷ Cf. section 6.1 for why Lucretius’s discussion of destroyed species is, conceptually, not ‘extinction proper’.

crop up during the Middle Ages [or] the Renaissance’ [Kolbert, 2014; 24], only first becoming fully articulable after the ‘biogenic hypothesis’ for the origin of fossil-materials emerged, first championed by da Vinci and Steno. Having reached London’s Royal Society at the seventeenth century’s close, thinkers like Martin Lister, Robert Plot and John Ray were the first to cogently explicate the fact that, in accepting this biogenic hypothesis, one consequentially commits oneself to accepting that species have disappeared from the planet: certain fossils—such as the *Megalosaurus* thighbone reported by Plot [1677]—simply did not have extant analogues [Stewart Thomson, 2005; 134]. Thus, between Lister [1673] and Ray [1693] we find first explication of extirpation as a theoretical entailment of the biogenic hypothesis and, therefore, first articulation of ‘species extinction’ as coherent hypothesis. Lister wrote, in 1678, of fossil shells representing “animals [that] *have become extinct*” [1678; 199]. This was merely a negative articulation, however; raised only to discount the biogenic hypothesis [Roos, 2001; 180-3].⁸ Lister [1671], indeed, inveighed against organic origins for fossils—*precisely on pains of the entailment of extinction*—thus returning to the age-old “*lapides sui generis*” explanation. Ray, contrarily, ingeniously circumvented the issue: accepting biogenic taphonomy, yet denying the consequent entailment of extinction, by qualifying that the absent animals must (*qua* plenitude) still exist somewhere in *terrae incognitae* [Poole, 2010; 115-34]. (This remained a go-to defence until Cuvier’s time: used, notably, by Jefferson to argue the “mammoth” still alive and well in the Americas [2011; 296-7].) Nonetheless, though not often noted throughout the literature, *the very first unequivocal endorsements* of species extinction came from Robert Hooke and Edmond Halley.

⁸ From Lyell [2009; i.31] onwards, people have nonetheless misclassified Lister as first to *endorse* extinction [Brasier, 2015].

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Hooke, across thirty years from 1667-94, and Halley, from 1690-1705, presented increasingly ‘explosive’ statements to the Royal Society regarding terrestrial chronology [Genuth, 1997; 276]. These are among the first recognizably *geohistorical* conjectures. The former proposed Earth history riven by gigantic earthquakes, wherein the planet’s ever-changing surface led to “divers *Species* of Creatures” becoming “quite lost”, with “no more of them surviving upon any part of the Earth” due to their habitats being “swallowed up” [1996; 435]. Hooke used this to explain fossils, thusly first endorsing ‘disappearance of living species’ [Rossi, 1987; 14].

Not long afterward, Halley expanded Hooke’s theorisation, providing modernity’s first image of a planetary-scale extirpation of life, or, *mass extinction event*. He speculated, that is, that the “causal shock of a comet” could cause such a cataclysm that “all things [living] should hereby be destroyed” [1723; 122]. Though entirely heterodox at the time, Halley maintained that this had happened multiple times antecedent to the current “Creation”: each time, he reasoned, *entire worlds* of unknown phyla had been wiped out, hereafter preserved only as “petrified” remains [1723; 122]. Such opinions weren’t well received, of course [Drake 1996; 142].⁹ Nonetheless, we note that both Hooke and Halley—as early as the late-1600s—had lucidly proposed entire genera had been “wholly destroyed and annihilated”.

Indeed, reports of ongoing extirpations soon began returning from the colonies. Despite humanity being the cause behind largescale destruction of other species since at least the Pleistocene [Leakey, 1995; 171-3], it was only during the 1700s that people started to *notice* these consequences of human

⁹ Halley’s controversial theories lost him a potential position as chair of astronomy at Oxford. His paper remained unpublished until 1724. Nevertheless, Newton appears to have held similar beliefs; he resolved, however, to keep them private [Genuth, 1997; 150]. Halley’s own speculations were inspired by an unnamed interlocutor, who has variously been identified as Newton [Levitin, 2013] or Hooke [Schaffer, 1997].

migrations (again, a latency pinpointing the dependence of observation on theory).¹⁰ The demise of the Mauritian dodo (which passed out of existence around the time of Halley’s theorisations) would go largely unnoticed until 1833 (despite some recording its absence as early as 1763).¹¹ Yet explorers in the 1780s keenly documented the decline of species such as the great auk in Newfoundland [Roberts, 2007; 42] or the sea-cow of the Aleutian islands [Tucker Jones, 2014]. Parson-naturalist Gilbert White had even begun, contemporaneously, to document wildlife extinctions on his doorstep in bucolic Selbourne [Scott, 2009]. From here, we note a telling quirk in this story: people were, by and large, markedly more willing to unequivocally accept anthropogenic nonhuman extinctions, and invariably did so *before* they would concede naturally-caused cases. Instances of this range from Lamarck [2011; 44] to Lyell [2009; ii.141-57]. An 1806 *New Monthly* article is exemplary on the matter, denying naturally-caused extinctions, yet emphasising ones following from the “destructive agency of civilized man” [anon., 1806]. Again, this speaks to the fact that sensitization to extinction emerges from empirical-level inquiry as much as—and in tight step with—framework-level shifts in our self-conception: chauvinist presumptions that humanity alone holds the requisite agential leverage to cause irreversible natural change is consequence of an age-old metaphysical framework that presumes nature as essentially ahistorical. Moreover, precise vocabularies within which to theorise nature’s contingency and historicity (as autonomous from human chronology and agencies) were only first beginning to consolidate. (In this expressive incipience, metaphor again acted—for better and for worse—as

¹⁰ Poetically, the organisms wiped out in this first anthropogenic extinction event of the Quaternary were also the first prehistoric animals to be documented during the eighteenth- and nineteenth-centuries: *Mastodons*, *Mammoths*, and *Megatheria* are all Pleistocene megafauna.

¹¹ Cf. Parish [2013; 129-31], Turvey & Cheke [2008], and Broderip [1833].

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‘semantic crutch’: we note that the *Naturphilosophen*, notably Kielmeyer [1938; 63-4] and Schelling [2000; 21], expropriated voluntaristic terminology, in lieu of more precise terminology, in order to communicate nature’s historicity and capacity to cause extinctions: articulating it as a type of ‘self-harm’ or ‘omnipotence’.) We explore this theoretical backdrop, concerning geohistory, more fully in the next chapter; for now, we move onto the other requisite areas of conceptual competence for prognosing X-risks.

4—POLITICAL ARITHMETIC, 1721-1818

As we explore in the next section, the eighteenth century saw the consolidation of mathematical probability. The birth of actuary, in turn, saw rise of a new field of study: demography. The year 1721 (three years after the first probability textbook was published [de Moivre, 1718]) saw the very first full enunciation of the possibility of *human extinction*. It issues not from fossil observances, but from the emerging pursuit of “political arithmetic”: coming from Baron de Montesquieu’s anonymously penned epistolary novel, *Lettres persanes*. Here, Montesquieu’s interlocutor argues that global population has definitively decreased since antiquity:

After doing calculations as exact as possible [...], I have concluded that the earth supports barely a fiftieth of the population [of] Caesar’s day. What is astonishing is that the population continues to diminish daily, and if this trend persists, within ten centuries the earth will be nothing but an uninhabited desert.

[2008; 150]

Entirely desacralized, stripped of chiliastic residue, lacking all fanfare, the *philosophe* here presents likely the very first scenario predictively forecasting the irreversible cessation of the species *Homo sapiens*. There are five points to note here. First, it is realist, in the sense that the “desert” world continues without us; second, it is naturalistic, in that it is born entirely of mundane and tractable

dynamics; third, there is no apocalyptic disclosure of veiling meaning or ‘sense of an ending’; fourth, it is long-term and planetary-scale in scope (“within ten centuries the earth...”); and, finally, it is identifiably the output of ‘rational prognosis’ (rather than ‘mystical augur’) insofar as it is derived, reportedly, from “calculations”. Importantly, it is born of the new-found understanding that mathematics can be applied to reality to *predict* its future course.

It is no accident, therefore, that multiple demographic treatises across the ensuing century contain similar musings on future human cessation. In 1754, Hume would pen an essay on “populousness”, responding directly to Montesquieu. Here, Hume too would be led to picture that “man, equally with every animal and vegetable, will partake [in eventual annihilation]” [2007; 108]. Moreover, the place of Malthus’s seminal 1798 work—though not anywhere explicitly engaging extinction prognostics—is self-evident within this lineage, as many have already noted [Clarke, 1979; 42-3]. Malthus’s targets of invective, of course, were the demographic assumptions underpinning Godwin’s political philosophy.

Even Godwin’s *Enquiry*, however, had previously asked:

But has improvement been the constant characteristic of the universe? The human species seems to be but, as it were, of yesterday. Will [humanity] continue for ever? The globe we inhabit bears strong marks of convulsion, such as the teachers of religion, and the professors of natural philosophy, agree to predict, will one day destroy the inhabitants of the earth. Vicissitude therefore, rather than unbounded progress, appears to be the characteristic of nature.

[1798; i.452-3]

In a later text, following his spat with Malthus, Godwin notes that multiple demographers have predicted the “extinction of our species”: here, from 1820, Godwin looks back to Montesquieu’s original 1721 forecast, glossing the *philosophe*’s claim that “the human species is hastening fast to extinction” [1820; 100]. What is it about demography, then, that caused early prognostics of extinction to cluster around it?

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Demography initially arose through the applications of nascent probabilism to mortality rates [Hald, 2003; 116-43]. More specifically, it is largely as a by-product of annuity computations during the latter 1600s that inquirers first noticed that what we now call ‘population’ was an object in its own right: with its own identifiable regularities, lawlike features, and dispositional properties; macroscale qualities, that is, that are *not* observable at the mesoscale of individuals. Only after the first steps in actuarial science (e.g. John Graunt’s discovering of statistical regularities in mortality rates [1662]), following from development of probabilism’s tools of abstraction, does the object of inquiry known as ‘population’ first consolidate. Previously invisible, populations solidified as targets of objectivity, insofar as their mechanics became capable of being modelled, reconstructed, and predicted. Thus, as the microscope was to the bacterium, the telescope to the planets, so statistics was to human populations.¹²

Certainly, this heralded brand-new awareness of mankind as ‘global mass’ [Foucault, 2004; 242-3]. With the coalescence of these ‘new realities’, of course, came new avenues of power (Foucault’s much-discussed ‘biopolitics’ [2007; 75]) but also there came *a new unit of potential perishing*. For some, of course, breakthroughs like Bernoulli’s ‘Law of Large Numbers’ [1713] reiterated invariance and eternalism (with the *Encyclopédie*’s “Population” article comparing statistical uniformities in birth rates to the symbolically unchanging system of planetary orbits [Cole, 2000; 28]). For others, however, we have seen that the consolidation of population-as-object brought the possibility for its cessation (indeed, this is one of the features of ‘objectivity’ itself: wherein science is capable of producing ‘lawlike’

¹² Like any other of science’s ‘theoretical entities’, it is empirically unobservable, yet becomes ‘inferentially reportable’ through statistical literacy [Brandom, 2014; 16].

statements precisely because it enquires into ‘boundary conditions’ under which an object or variable *does* and *does not* obtain or persist). Thus, the computations of risk that had made population first visible, also ensured population was itself now subject to riskiness.

‘Population-thinking’, moreover, supplied three important insights essential to developing notions of existential risks. First, as fusion of base nature with high-minded politicking (statesmen, following demographic awakenings, “talk of nothing but propagating the species” one commentator complained [Blum, 2002; 55]), political arithmetic forces sensitization to our ‘biological rootedness’ [Foucault, 2007; 75], thus stressing the *supervenience* of sapience upon a material substratum subject to vicissitude. Secondly, via facilitating enumerative thinking regarding population dynamics, the arithmetical nature of species decline becomes available, incipiently highlighting the *numerical granularity* of species-extinguishment: underscoring, in other words, that our species could die out in a granular and sequential fashion, rather than univocally and simultaneously as is prescribed by apocalypse. (This materially entails a terminarch: an insight essential to popular imagining of “the last of the human race” [Redding, 1811; 25].) Last but not least, is ensuing concretization of humanity’s awareness of itself *as a species*. “Species”, following John Ray [1686], had become definable as an organic form fixed by reproductive continuity: thus, via centring conception of humanity as *reproductive community*, population-thinking inculcated taxonomic self-awareness. Cemented in Linnaeus’s inclusion of the genus “*Homme*” [1766], it was during this period that ‘men are no longer called “mankind” [and] begin to be called “the human species”’ [Foucault, 2007; 75]. It is no coincidence, therefore, that Grainville commenced composition of *Le dernier homme* in 1796, the year Malthus’s *Essay* was released [Michelet, 1875; 110].

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And so, through conceiving of humanity as a species alongside other species, naturally comes the idea of mankind's supersession. We see this clearly in MWS's *Frankenstein*. Though it is rarely noticed (with exception of Willis [2006; 89], Page [2012; 71-110], Armstrong [2006; 118], and Bradley [2012; 131]) the prospect of human extinction is encoded as an implicit threat, thus core narrative stressor, within the novel. Certainly, we can frame *Frankenstein* as a culmination of our 'biopolitical' lineage of demographically-oriented thinking upon human extinction.

That is, beginning with the encounter on the glacier, the monster addresses his threats not just to Victor but to the "rest of mankind" [1999; 125]. Why is this? It is because the monster is not a reanimated human, but a member of a *new species*. Victor's taxonomically aberrant creation possesses "stature" surpassing all men [57], a frame "more supple" [126], a wildly variant diet [145], all alongside unparalleled endurance, speed, and strength. It is, in short, "superhuman" [125]. The monster itself exclaims that it is "not even of the same nature [as] man" [145]; and Victor, in manufacturing the creature, straightforwardly decrees he aims to create a "new species" [82]. The creature's genesis, to put it simply, arises not merely as a re-animation of pre-existing parts, but as a speciation event. (Transmutation was, in some capacity, variously accepted at the time; the mechanism behind speciation remained vague and unknown, of course; thus, the creature's laboratory phylogenesis would have sufficed as plausible within the fiction.) Recuperating the creature's true biological import as such, a major mechanism of the novel's thematic functioning is restored: prevailing interpretation—occupied with 'reanimation'—constrains the monster as individual teratism; only through recouping its genesis as speciation event, however, do we rehabilitate the creature's true nature as *arithmetical threat*.

The implicit danger of Victor’s creation lies therefore not merely in its physical aberration, but in its status as *demographic potency*: the potential for the proliferation of a competing population, or, nonhuman body politic. This encoded potential for population growth, indeed, consolidates the creature as a “species” exactly in line with Ray’s reproductive classification (individual teratisms—as deformities or hybrids—are sterile and lack capacity for viable procreation). Ray’s definition, moreover, helps resuscitate the significance coded by the monster’s request for a female compatriot: Victor presciently infers that obliging the creature’s supplication for a female “companion” would properly consecrate this “new species”—ensconcing it within the ecosystem via possibility of sexual reproduction and inaugurating a new germline—thereby enabling deadly interspecific antagonism. He feverishly prognosticates that “a race of devils would be propagated upon the earth”; a scenario likely keyed into Malthus’s notion of “geometric growth”.¹³ Accordingly, Victor decides against manufacturing a sexual partner for the monster, judging that delivering on this request would be procuring his own “peace at the price perhaps of the existence of the whole human race” [190]. Victor, therefore, adjudicates his “duties towards beings of [his] own species” are more demanding than appeasing the monster [238]: he “could not sacrifice the whole human race”, he avers [209].

Just as with PBS’s *Prometheus*, MWS’s *Frankenstein* embeds ‘human extinction’ as a subjunctive hazard and, thereby, as the core narrative stake. The monster’s body is encoded with the demographic potential for geometric growth: precipitating interspecific antagonism and ultimately leading to

¹³ This episode strongly resembles the “frightful progeny” glimpsed in Grainville’s *Le dernier homme*: similarly displayed as potential futurity. Should Omegarus and Syderia procreate, we are warned, a “hideous progeny” would be consecrated; duly averted by Malthusian celibacy, this potential progeniture—Cainite, cannibalistic, and “making perpetual war on one another”—is projected as eternal subsistence crisis [2002; 91-100].

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extermination via competition and overshoot. Fear of the monster, then, is ultimately fear of abstraction; the threat of not one life, but the teeming, over-fecund, supra-organic ‘life’ of statistical macroscales. The creature is the incarnation of the unease born of demography’s miscegenating of number and flesh. Certainly, demographic science accomplished a ‘geometrization of sex’ to rival the prior ‘geometrization of space’: with Malthus’s “geometric growth”, calculating “premature death [for] the human race” [1992; 42] becomes as analytical as computing planetary orbits. Indeed, insofar as the monster relies on this predictive dimension for its full narrative weight, it relies therefore on readers’ mastery of the concept of risk.

A century prior to *Frankenstein*, Montesquieu had catalogued a dizzying surfeit of “catastrophes which so often brought humankind within a hair’s breadth of extinction”:

Human beings, dwelling in a place so subject to change, are in [an] uncertain state; a hundred thousand causes may be at play, the least of which can destroy [their] number.
[2008; 151]

Thirty years subsequent, in 1755, the earthquake-stricken ruins of Lisbon only compounded such an analysis. Statements such as Montesquieu’s epitomize a shift away from encountering our cosmic environment as the infinitely-including cradle of qualitative worth and security explored in the previous chapter, and toward apprehending it as an enveloping topography of hazards that must perpetually be navigated by quantificatory orienteering and unceasing course-correction.

5—EXISTENTIAL ACTUARY, 1565-1812

Insofar as you are reading this, human extinction remains a risk rather than a reality. As therefore constitutively surpassing prior availability and experience, a rigorous understanding of uncertainty was essential to its enunciation. As we are about to explore, the seventeenth and eighteenth century

emergence of probabilistic science not only allowed traction upon the ‘aleatory’ dimension of observed natural events and their frequencies (thusly allowing numerical prediction of the future and, ergo, the emergence of practically meaningful forecast) but, in concomitantly instigating a robust science of decision, it also incepted a ‘doxastic’ understanding of risk as a heuristic measure of epistemic ignorance and uncertainty (which, in thereby relinquishing ‘risk’ from the boundedness of observed frequency, allowed a conceptualization of threats unconstrained from *any* prior availability such that ‘threat’ could additionally extend to dangers as yet unobserved, or, indeed, unobservable as such). This latter development, in mathematically formalizing rationality’s drive to constantly update its beliefs by endlessly tracking their defeasibility and corrigibility, implicitly opposes any circumspect foundationalism that attempts to insure some privileged belief against fallibility and, thus, founds it in non-conceptual nature: accordingly, the emergence of this ‘science of uncertainty’ is here considered as part and parcel of the wider expatriation of reasons from nature—or, loss of amniotic inclusion—that facilitated sensitivity to reason’s cosmic precarity.

5.1—précis on the prehistory of risk, pre-1763

‘Risk’ was conceptually formalized *post hoc*—undergoing an intensely belated mathematical birth in seventeenth century Europe—and yet it retroactively commands a vast prehistory. Indeed, navigation of hazard is the universal backdrop of organic and sentient existence (as Darwin first implied, through the hint of Malthus). Sapient *self-representation* of danger, however, is likely uniquely human: first affording conceptual, rather than merely instinctual, navigation of dangers. This affords the recursive aspect constitutive of ‘risk proper’. (Risk, that is, is necessarily self-situating: there is ‘no risk without our knowledge of it’ [Nacol, 2016; 132], or, ‘[d]anger are *dangers for someone*’ [Garland,

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2003; 51]; thus, through said reflexivity, sapient humans achieve the first ‘navigation’ of threat worthy of the name; because, quite simply, ‘[h]azards are undergone, whereas risks are *taken*, or adopted’ [Land, 2014; 363].) In other words, humans appear to have the unique capacity to be representationally cognizant of risks, hence to anticipate and manipulate them, relying on planning and strategizing rather than fear-response [Suddendorf, 2007]; what’s more, we concomitantly wield the capability to be aware of non-present, unseen, and distant threats [Giddens, 1991; 127-8]. That is, our anticipatory self-representation of peril is deeply attached to what evolutionary psychologists call ‘*proscopic chronesthesia*’, ‘*autonoetic consciousness*’, or, more prosaically, ‘*mental time-travel*’ [Tulving, 2002]. Likely coterminous with goal-orientation, tool-use, and executive function, it is currently being contended that this ‘chronesthetic’ aptitude derived from expansion of our ‘working memory’ [Collidge, 2005 & Ambrose, 2010]; this withstanding, such capacity is clearly also conditional upon the emergence of language-use [Tattersall, 2004]. Language, that is, contains *modal locutions* (concerning ‘possibility’, ‘necessity’, ‘contingency’) which underwrite forecasts, counterfactuals, and conditionals (all required to grasp and self-represent risks). Borghini notes that ‘the ability to reason using modal notions is characteristic of humans, and is certainly remarkable, arguably playing an important role in our evolution and setting us apart from other intelligent beings’ [2016; 19]. Language, operating as a highly distributed descriptive model of the world, granted humanity an additional ‘interface’ with said world—an interface superadded to sense receptivity—yet one not governed solely by the local exigencies and claustrophobic immediacies of incoming sense-data (tethered necessarily to an expedient present) but rather by more non-local concerns (such as, *qua* rule-governed system, global criteria of correctness and coherence, which arguably *require* mastery of basic modal terms as

conditions of regulative function [Brandom, 2014]). Language-use, first piercing the absolutism of immediacy, provides a world-model abstract enough to become separable, or ‘delaminated’, from the mere present: triggering navigation of counterfactuals (‘modal locomotion’) and, with it, prognostication.¹⁴ What’s more, epitomizing what Leroi-Gourhan [1993] called ‘exteriorization’, language facilitated transmission of ‘recipes’ for mitigation stratagems across generations and groups. This special skillset explains why *only* humans developed agriculture and urbanized: advances representing the first widescale—albeit *ad hoc*—attempts at *risk mitigation* and *risk distribution*. The key term is ‘*ad hoc*’, however: it remained this way, more or less, until Europe’s shift from feudal to preindustrial economies. That is, up until late-medieval society, risk mitigation remains ubiquitously constrained to mere emendations of these crude, extemporaneous buffers against unpredictable nature: i.e. improvements to the surpluses of agriculture and the fortifications of townships, bolstered only by piecemeal advances throughout the ages in areas such as ‘crop specialization’ and ‘rotation systems’ and new methods for ‘managing wind and water’, all in order to ‘offset devastations caused by famines, droughts, and storms’ [Merchant, 2016; 64-7].¹⁵ But, then, midway through the seventeenth century, something changed. Risk became measurable and forecast opened up. Accordingly, the mid-1600s represent the first time that “*risk*” entered ‘the English lexicon’: percolating first through the ‘professional vocabulary’ of maritime traders and their underwriters [Nacol, 2016; 2 & Luhmann,

¹⁴ Empowering ‘delamination’ is a recurrent aspect in theories of anthropogenesis ever since Herder titled us the “*Mängelwesen*” (‘creature of deficiencies’) in 1784. Thereafter inherited by Alsberg and Gehlen’s theories of hominization, it continues into Gould’s [1977] exploration of our ‘empowering underdetermination’ by way of humanity’s exaggerated developmental neoteny.

¹⁵ ‘Calamity’ may derive from ‘*calamus*’—denoting ‘stalk’—relaying risk of famine via crop-failure [Huet, 2012; 3].

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1996]. With a coeval explosion of insurance industries, alongside maturation of financial markets and speculation thereof (opening an entirely unforeseen species of calamity in the form of economic bubbles), possible futures had become profitable and risk a lucrative business (derivatives became maligned in so-called ‘tulipomania’ just as governments begin funding themselves by selling annuities): with this, parallel to new fixations with ‘prudence’ and ‘predestination’ flowing out of Protestant reformation, the future increasingly came to influence the present.¹⁶

From Luhmann [1993] to Giddens [1991], Lupton [1999] to Beck [1992], sociologists variously agree that ‘mastery of risk’ is, in some important way, the threshold of ‘advanced modernity’: debuting, along with it, the modern ‘world of speed, power, instant communication, and sophisticated finance’ ascendant today [Bernstein, 1998; 2].¹⁷ It is, undeniably, against this backdrop that grasp of risks specifically existential in severity first solidified (much of the 1990s surge of ‘risk scholarship’ fails to pay attention, however, to ‘X-risk’ given that its technical lexicon has only lately matured). Probabilism, in other words, is self-evidently an essential ingredient in articulating extinction. There is long-running mystery, however, over probabilism’s belated birth; or, why ‘probability calculus was so long developing’ [David, 1962; 36]. For, not becoming ‘significant scientific conjecture in European

¹⁶ Though the institution of insurance (as transferal of risk to a third party in return for premiums) dates back to 1800 BC, it began to explode during the so-called ‘late medieval commercial revolution’, growing rapidly through the seventeenth century and famously clustering around coffeehouses such as Lloyd’s of London, whilst finally reaching ‘full development as a commercial concept’ in the eighteenth century [Bernstein, 1998; 92].

¹⁷ Missing from Bernstein’s line-up is the domain of *algorithmic intelligence* and *machine learning*: itself posing significant near- and long-term strategic threats to *Homo sapiens* [Bostrom, 2014], alongside some of the most exotic problems imaginable in game theory and decision theory (e.g., ‘Roko’s basilisk’: an update of Pascal’s Wager, replacing Christian godhead with future AI superintelligence [Turchin, 2017; 29 & Singler, 2018]).

discourse until the sixteenth and seventeenth centuries’ [Beck & Kewell, 2014; 22], probability long remained, as Hacking [1975] put it, ‘an absent family of ideas’. (Unlike many other mathematical fields, that is, which find at least embryonic expression in Ancient Greece.) Of course, in sortilege (divination and casting of lots) and astragali (heel-bones used as dice), we excavate the beginnings of ‘luck epistemics’ and a ‘prehistory of randomness’ all the way back to c.3500 BC [David, 1998; 4].¹⁸ Yet this was perennially apprehended as impenetrable “*fortuna*” rather than anything formally tractable: until, that is, Gerolamo Cardano’s *Liber de Ludo Aleae* (written c.1552, though published posthumously in 1663). In this germinal meditation upon ludic randomness, Cardano ‘conducted the first real experiments in the mathematics of chance’ [Beck & Kewell, 2014; 18]. Cardano’s breakthrough (now deceptively intuitive yet at the root of the entire modern world) was in inaugurating conceptualisation of each dice-throw as *the expression of a larger set of enumerable possibilities* (‘equipossibles’) thus developing the notion of an abstract ‘sample space’ (entitled by Cardano the “circuit” of the die) and, further, in employing numeral notations (namely, fractions) to track frequencies within this reference class. The notion would have wait until 1654, however, to be applied as ‘predictive forecast’ proper: namely, in Pascal’s celebrated solution to the so-called ‘Problem of the Points’ within his correspondence with Fermat [Devlin, 2010]. Here, for the first time, numbers were deployed to *robustly measure future outcomes*.¹⁹ This, therefore, is the birthplace of future forecast. With this, our evolutionary endowment of foresight was combined with the unprecedented power of calculation, and

¹⁸ Our word ‘hazard’ comes from the Arabic for dice: ‘*al zahr*’. ‘Aleatory’ comes from Latin for the same.

¹⁹ Pascal used a number triangle to compute the cascading number of possible results from an interrupted game of chance such as to properly allot winnings between players, given distribution of the likelihood each player *would* have won *had* the game finished.

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we hereby find the earliest germ of our contemporary ‘culture of prediction’ [Heymann et al., 2017], its worldwide ‘megastructure’ of ‘planetary computation’ [Bratton, 2016], and our epistemic gestalt of ever-deepening future-orientation.

Conspicuous absence of such understanding, prior to the sixteenth and seventeenth centuries, is integrally important here because it directly impinges upon lack, similarly prior to this juncture, of any propositions concerning extinction. Late-medieval economic factors are often cited as explanations for probability’s emergence and so too is Fibonacci’s thirteenth century explication of arithmetic alongside the introduction of place-value notation; nonetheless, it also concerns a wider philosophical step away from the lifeworld of the tangibly apparent (i.e. its intentional contentfulness and qualitative topicality) and instead towards abstract formalisations (the ‘topic-neutrality’ of enumerations, sample spaces, equipossibles, etc.), alongside newly attendant willingness to move away from anthropomorphic heuristics of “fortuna” and “fate” and toward, in their place, the ‘*de-semantification*’ wrought by number as formal and purely operative system [Novaes, 2011 & 2012].²⁰ In other words, cognition (ironically) gains practically meaningful grasp upon the future only inasmuch as it relinquishes said ‘future’—and its conceptualisation—from the fetters of guaranteed meaningfulness and qualitative contentfulness (as exemplified by ancient apprehension of the future as repository of self-presenting meaning, whether through oracular prophecy or apocalyptic teleology) and insofar as it, instead, submits futurity to the de-semantified and nakedly operative computability of formal systems (such as, *inter alia*, probability or calculus). The ‘future’, that is, only becomes intelligible as a target of prediction

²⁰ Krämer [2003] classifies ‘calculation’ a ‘technique of forgetting’, in that its pure ‘operativity’ lies in forgoing inherent ‘meanings’ entirely.

insofar as it is stripped of self-presenting meaningfulness; or, gains in intelligibility are won by forgoing heuristics that secure futurity as an automatically meaningful category and, accordingly, concomitantly forego the presumed security of ‘meaningfulness’ *as such* within this futurity. This, indeed, is precisely where the Early Modern mathematization of chance keys directly into the eventual articulation of X-risk: the rational actor, in other words, gains predictive traction upon future outcomes *only insofar* as she becomes responsive to their autonomy from her hermeneutic appraisals, which, in turn, is precisely coincident with sensitization to the future precarity of hermeneutic content *simpliciter*.

Appropriately, it was therefore not long until probability was indeed applied to compute the odds of global catastrophe. For, following Pascal, Jakob Bernoulli [1713] and Abraham de Moivre [1738] made further breakthroughs that extracted probability calculus from the gambling table and demonstrated its applicability across ‘all kinds of world phenomena, such as births, deaths, accidents’, etc. [Gorroochurn, 2016; xxi]. (Bernoulli’s work, especially, proved foundational for the maturation of demography.) Beyond probability, Jakob also contributed to astronomy, where he attempted to compute the return of the “Comet of 1680” [Bernoulli, 1682]. His prediction failed, earning him posthumous ridicule from Voltaire [1773]. Only in [1705], did Halley (another important figure in the history of statistical actuary) correctly forecast the comet’s 1758 return. Nonetheless, this success demonstrated the numerical tractability of cometary paths. Probabilism, nonetheless, had yet to be leveraged upon the issue: for, despite the fact that the *possibility* of collision had been floated since the time of Whiston [1696] or Maupertuis [1724]—with Halley deeming impact “by no means impossible” [Gleiser, 2001; 84]—the *probability* of this eventuality had yet to be computed. Given intervening advancements, however, it was merely awaiting calculation. This came from Joseph de Lalande, who,

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in [1773], prepared a tract entitled *Réflexions sur les comètes*. Therein, Lalande calculated the odds of the earth's intersection with a comet as “76 mille contre un”, or, 1/76,000. Though Lalande's intention was to assuage superstitious fears of comets with this ‘low’ likelihood, public comprehension of probability was incredibly low, and sensationalized reporting of his paper instead caused ‘furor’ and ‘popular alarm’ in Paris. Accordingly, for his efforts, Lalande also attracted Voltaire's animus [Stewart, 1986; 22].²¹ Public hysteria notwithstanding, however, we have here *the very first probabilistic forecast of an X-risk*.

Shortly after, du Séjour [1775] extended Lalande's work ‘with all the additional precision which statistics could bring’ [Stewart, 1986; 22] allowing him to proffer more detailed calculations. Laplace, who reviewed this work, was excited by this innovative application of the art of conjecture: igniting his ‘interest since it called on elementary notions of probability to make its case’ [Hahn, 2005; 68]. Soon famed for his creative fusions of mathematical method and astronomical problematics, Laplace was clearly inspired. Thus, just as he would apply probabilism to ‘shed light on the origin of comets’ [Heidarzadeh, 2007; 193], he soon deployed it to compute his own odds of their threat.

As the first to quantify the relatively small mass of most cometary bodies, Laplace lowered probability of collision; moreover, he assuaged old fears about our planet being ‘asphyxiated’ by intersecting with the gases of a comet's caudal trail; notwithstanding, and despite vacillating on exact weightings of severity and likelihood [Genuth, 1997; 210-14], he nonetheless maintained that “the small

²¹ Despite his ridicule, Voltaire had, himself, previously been arrested by the “disaster” precipitated by collision. “[T]wo bombs”, he wrote, “which burst on clashing in the air” provide an analogue (albeit one “infinitely” smaller) [1995; 340]. Stripped of apocalyptic meaningfulness, ‘annihilation’ is here rendered into a problem for Newtonian ballistics. Worlds and cannonballs are identical; it is merely a question of scale.

probability of this circumstance may, by accumulating during a long succession of ages, become very great”. Laplace, next, entered upon a thought-experimental abduction of the “effect of such a shock upon the earth”:

axis and motion of rotation changed, the waters abandoning their antient [*sic*] position, to precipitate themselves towards the new equator; the greater part of men and animals drowned in a universal deluge, or destroyed by the violence of the shock given to the terrestrial globe; whole species destroyed; all the monuments of human industry reversed

[1799; ii.63-4]

With this, and despite his appending attempts at assuagement, Laplace produced a vision of our ineluctable placement within a cosmic field of jeopardy that immediately riveted contemporary consciousness. Indeed, it was oft-quoted in British reviews of Laplace [e.g. anon., 1810; 407] and it forms the basis of the *New Monthly* article on a “very rational end of the world”: wherein it is paraphrased—alongside Lalande’s predictions—as the prognostications of a “great geometrician” [anon., 1816; 210]. The “probability of such a disaster is daily increasing”, the article glibly notes.

And thus, it was German astronomer Wilhelm Olbers (cosmological catastrophist and asteroid cartographer) who, in [1810], converted Laplace’s “long succession of ages” into a precise timeframe.²² He computed, that is, a stretch of 220 million years per collision; whilst stating that, for every 439 million intra-solar comets, *one must strike us*. With this, he significantly upped du Séjour’s nearly-negligible odds.²³ And, just like Laplace’s before him, Olber’s ‘cosmic risk analysis’ reverberated

²² He also gave us ‘Olber’s Paradox’ which asked why, if space is infinite and filled with infinitely many suns, *is the sky so dark?* This has since been solved by Big Bang cosmology; however, it is sometimes compared to today’s Fermi Paradox [Almár, 1992].

²³ He was still underestimating: contemporary calculations put extinction-level collisions—a kilometer across and capable of triggering ‘impact winters’—at ‘once every 500,000 years’ [Torres, 2017; 69-71].

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throughout journals in the coming years [e.g. anon., 1819b; 542]. With yet more astronomers producing their own impactor probabilities thereafter [Milne, 1828; 116 & Arago, 1832; 48], we see how it was that the unveiling of nature’s aleatory mechanics concordantly reconfigured our relationship to it: revealing our cosmic backdrop—not as a life-support system—but as an enveloping field of roaming hostilities.

5.2—relinquishing risk from frequency, post-1763

Despite undoubtedly extending the field beyond mere games (and into the incipient domain of global forecast) the advances in probabilism up until the mid-1700s retained in common with their ludic origins a basic movement from *known quantities* (be it a dice throw, quantity of intra-solar comets, or an urn of pebbles) to their *expected effects* (be it gambling odds, earth-comet intersections, or iterative proximity of expected selection and selected results) [Desrosières; 1998; 56]. In other words, there was a tendency to construe probability simply as ‘frequency’.

Yet, another guise of probability—persistent yet often dismissed—had long been intimated. It was often expressed as the reverse of the above: accordingly dubbed “inverse probability” [Daston, 1995; 226-95], it queried how to accurately assign, from *observed effects*, probabilities as the precise measurement of our confidence in our reasoning upon *unobserved causes*. Thus, rather than measuring frequencies within an objective series or class, numerical values were here employed to track our confidence or degrees of belief regarding the unknown. Ever since the *Port-Royal Logic* [1662] first applied probabilities to inference, and Pascal’s ensuing wager [1670] conducted risk-benefit analyses concerning issues of religious belief (thus producing the ‘first well-understood contribution to decision theory’ [Hacking, 1975]), there had been insinuation of this alternate ‘probability’: one referring not to

things but the mechanics of inference itself. Consecrated by Bernoulli's bifurcation of "subjective" and "objective" probabilities [Hacking, 1971; 213-4], it has in our time been taxonomized by Carnap as probability₁ and probability₂ [1950; 19]: denoting probability as 'doxastic weighting' and as 'aleatory frequency', respectively.

What is crucial here is that the historical emergence of probability₁ is highly indicative of a reformulation of 'truthfulness' as *constant approximation* rather than a *foundational given*, which, in turn, keys into the wider reconfiguration of cognition's relation to the cosmos (as one of insecure precarity rather than inclusive security) because it expedites the long-durational extraction of epistemic contents from inherence within a conceptual nature: as we see, the eighteenth century enunciation of probability₁ facilitated this long-durational loss of epistemological foundations, insofar as it insinuated a picture wherein we do not reason, analytically, from secure certitudes, but, instead, asymptotically approximate certainty by constantly updating our opinions relative to incoming data, and, thus, articulating probability₁ proffered an entirely novel picture of rationality wherein uncertainty is cognitively 'envirning' (as the point of departure for all inference), rather than one wherein 'true knowings', in order to be doxastically insulated from risk of fallibility, are grounded securely within non-conceptual nature (the important side effect of this prior presumption being that the entire enterprise of 'conceptual knowing' is insured against precarity at a fundamental level).

Probability₂—or, the 'frequentist' approach—necessarily bounds indecision to variation within an observed reference class. *In this way it inherently restrains threat to hazards previously experienced and witnessed.* This is of key importance because, as Ćirković explains, 'absolutely destructive events, which humanity has no chance of surviving [...] completely annihilate our confidence in predicting from past

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occurrences’ [2008; 123]. Here, probability₁ comes into play, because—as instead a measure of confidence in our beliefs and, thus, their instability—it can take into account the strategic position of observation and ratiocination *as such*, and justly articulate the class of risk baptized, in our own time, as ‘unknown unknowns’ [Torres, 2017; 38-9].

So it was that Reverend Thomas Bayes [1763; 392-3] wrote of our need for a rule of inference where we “absolutely know nothing antecedent to any trials”. Of course, this was, for Bayes, simply an exercise in responding to the academic problem of “inverse probabilities”, yet, nonetheless, it provoked him to produce the very first rigorization of probability₁. Though he of course had no idea of its world-changing applications, in Bayes’ theorem modernity first produced for itself a domain-agnostic (universally applicable) rule for reasoning under uncertainty. (It was left to Laplace, however, to properly apply and champion the theorem; he reached it separately [1774] through meditations upon how, statistically, to interpret unreliable astronomical data.)

Bayesianism’s barebones procedure is as follows: starting from a so-called ‘*prior probability*’ regarding some arbitrary hypothesis (a subjective assignation of likelihood that, *in extremis*, is entirely divorced from observed evidences, or, in other words is a ‘guess’) one adaptively updates one’s weighting in response to incoming evidence, thereby generating a so-called ‘*posterior probability*’. Closing the loop, this ‘posterior’ is fed back as a new, iterated ‘prior’ upon arrival of new evidence. *Rinse and repeat*. Bayes’ theorem, quite simply, first captured—with algorithmic rigor—reason’s activity as a self-updating system: it first insinuated the fact that reasoning isn’t rational because it has inviolable foundations but because it can track its violability and correct itself in light of novel evidence [cf. Sellars, 1997; 79].

What is important is that this procedure makes ignorance and uncertainty *epistemically informative*, rather than something to be eliminated (and this was its innovation over previous formalisations of inference). This, indeed, is what made statisticians, well into the twentieth century, suspicious of Bayesianism as ‘subjectivism’. Yet, its practical power and applicability prevailed [McGrayne, 2011]. Basically, if we can measure our ignorance, we can productively reason from it. We can thusly now ratiocinate (informatively) upon threats entirely beyond experience, precisely because lack of experience can concomitantly now be grasped as itself a measurable threat (given sensitization to ‘unknown unknowns’).²⁴ That is, ‘risk’ is extricated from bounded objective frequencies and, instead, expands to become cognition’s comprehending optic upon worldly matters, both theoretical and practical. And, thus, Bayesianism is ‘subjectivism’ only insofar as the ‘Bayesian subject’ is itself ‘subject to risk’ (whereas, in contradistinction, frequentism assumes risk, exclusively, to be a delimited object of observation, and it thus tends to take for granted the strategic security of observation itself). For, where probability₂ constrains incertitude to bounded variation within a given reference class, probability₁ decrees it as the pragmatically environing condition of decision, or, the heuristic starting-point of *all* inferences. This was enshrined in Laplace’s ‘Sunrise Problem’: wherein he employed his ‘Law of Succession’ (another formula capable of estimating likelihoods for unobserved or uninstanced events) to compute the probability of the sun *not* rising tomorrow (earning Laplace consequent mockery from ensuing frequentists) [Jaynes, 2003; 387-91]. The purpose of this exercise, however, wasn’t to argue for doom anytime soon, but to demonstrate that *all* claims (no matter their doxological

²⁴ Deeply relevant to X-risk studies, this type of reasoning reaches its modern-day apotheosis in ‘observer-selection’ arguments like Fermi’s Paradox [Ćirković, 2008].

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‘certitude’) are resolvable into the calculus of degrees of confidence. Thus, we do not embark from inviolable certitudes or secure foundations, we continually approximate them. This is important because this statistical picture of reasoning—though controversial at the time—unwittingly commits to the larger extraction of epistemic contents from naked existence. And, of course, it was prior assumption of existence’s inherent epistemic contentfulness that had perennially prohibited prospection upon epistemology’s terminus.

Loss of epistemic foundations, tellingly, can be traced back to probability’s earliest roots. Hacking’s [1975] explanatory picture for the emergence of probabilism, that is, is wholly rooted in the collapse of the scholastic system of demonstrative knowledge that presumed for nature an inherently rational structure and, thereby, founded truthfulness entirely in secure correspondence (explored in Chap.4). This ‘collapse’ is encapsulated by the transformation in the definition of “probability” itself across the Renaissance: from its premodern denotation as assent for the judicial weight of textual tradition (wherein the most “probable” source indexes that with the most normative authority) toward its modern definition of quantifiable (i.e. ‘de-semanticized’) weighting of causal likelihood (entirely disentangled, thereby, from normative valuation). Concurrent with this, the “sign” shifted from functioning via verisimilitude and qualitative analogy towards operating as inference from observed effect to unobserved cause, and “evidence” transmuted from appeal to scholarly tradition toward indexing nature’s causal testimony (wherein ‘testimony’ retains anthropomorphism only as linguistic skeuomorph or dead metaphor). Notably, the elder intension of “probable” is conspicuously anthropomorphic, allowing no distinction between scriptural authority and natural reality (the one *just is* the other). Modern probabilism emerges from the loss of this foundational correspondence. And

Bayesianism can be cast, thereby, as a culminating point of this long-range process: insinuating incertitude as the starting-point of all inference—and accordingly recasting certitude as continual approximation—it implies a picture of knowledge as foundationless, wherein ‘correctness’ is a value to be actively achieved rather than a factum passively received. In this, it tellingly resembles Kantianism’s near-contemporaneous redefinition of truth as coherence. We explore the parallel below, but here we note that it is precisely by extricating the *value* of correctness from foundational and factitious existence, that we come to be aware that such cognitive values are themselves ‘subject to risk’.²⁵

Kantian critique, in essence, casts knowledge as a system capable of elaborating its own limits—and, thus, incompleteness—in order to move toward a more holistically complete knowledge. Rationality knows ever better only by becoming responsive to the ineliminable corrigibility of its assertions. This defines Kantianism’s deep isomorphy with Bayesianism: each delineating active self-gaugings of inaccuracy that help approximate higher-degree accuracy [Strawson, 2016]. (It is highly revealing that Kant himself explicitly relates the practice of making assertions to that of “*betting*”. People, he writes, often “pronounce their views” with seeming certitude, yet it actually turns out, upon more rigorous inspection, that they value their “persuasion [at] one ducat, but not at ten” [CPR; A824-5/B852-3]. Everyday practical reasoning, in other words, involves material—rather than formal—*inference*, and is thereby measured in *degrees of credence*.) Thus, both Bayesian and Kantian pictures of reasoning start from incertitude (suggesting environing violability rather than inviolable foundations)

²⁵ Presuming ‘truth’ consists solely in unmediated correspondence—rather than involving a component of irreducibly normative evaluation—leads to strange dreams such as that of Laplace’s Daemon: implying that, if only we had eyes ‘big enough’, we could ‘see’ the entire truth. As a mind entirely insulated from its risks, however, the Daemon can be no mind at all.

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and explain ‘knowing’ as an *approach* to truth: caching out cognition as top-down regulation, relational to incoming sensory data, rather than bottom-up extrapolation from any given sensory or intellectual foundation. Their historical coevality, accordingly, is not at all accidental.²⁶

Ultimately, they identically cast reasoning as a model of the world that constructively incorporates the distinction between model and world within itself (or, relates to itself and its own assertional contents through a heuristic of risk): either by numerically tracking the distinction between expectation and observation in order to self-correct, or, alternately, as driven by critique to enhance the global coherence of its claims relative to one another.²⁷ They convergently cast cognition as a self-correcting model (approximating truth across risky terrain, open to revision and sensitive to precarity) rather than a microcosm cradled with perfect security within the macrocosm (an inclusive cradle vouchsafed by the juridical authority of some speciously personified nature). Such foundationalist ‘security’ is not just epistemic but importantly also automatically existential in scope. Indeed, as should now be clear, philosophical foundationalisms—of all stripes—offer for knowledge a *metaphysical insurance scheme*: construing truth solely as correspondence, they are led to define ‘knowing’ as constitutively opposed to fallibility and defeasibility, which, in turn, seals the entire edifice of knowledge from any risk of revocation (both existential *and* doxastic) insofar as they are conterminously led to reify epistemic

²⁶ Of course, Bayesianism was only much later applied to human cognition *as a whole* [e.g. Ramsey, 1931 & Clark, 2013]. Nonetheless, the *demand* for a rudimentary Bayesian approach (even if, originally, only intended for limited use-cases) was, given its separate explications across Bayes and Laplace, contemporaneously tangible: thusly illuminating the largescale theory-level shifts in self-conception relevant here. New problems demand new approaches; new approaches render new problems.

²⁷ Recasting truthfulness as an ongoing question of epistemic integrity rather than a foundational given, Bayesian reasoning parallels Kantianism’s ‘semantic holism’ and attendant rejection of ‘semantic atomism’.

concerns as facts of independent existence. Whereas foundationalism must thereby construe riskiness as utterly antithetical to ‘knowing’ (inasmuch as it can only see truth in unmediated correspondence), Kantianism and Bayesianism, contrarily, are alike in consecrating riskiness (that is, fallibility) *as the very medium of making and staking claims*: for it is only by measuring the fallibility of a claim that we can execute its update. Jeopardy is endogenous, rather than extrinsic, concerning all such episodes that properly count as ‘knowing’. This may, when it is extended across the entirety of cognitive contents, institute what Kant called reason’s “supreme tribunal” of self-correction and coherence [CPR; A740/B768]; but, by the very same token, it concomitantly immerses intentional content, in its totality, in precarity; such that, again, the Bayesian-Kantian subject is a ‘subject’ only insofar as it is ‘subject to risk’. Or, to be fully submerged in self-accountability is to be exposed to jeopardy to the highest degree.

And so, it is our contention that both ‘critical philosophy’ and ‘inverse probability’ emerged as a *pragmatic response* to emerging awareness of the precarity of epistemic values in the wider universe and, in thus convergently responding to and divergently giving voice to this problem, they congruently contributed toward its first explication *as a concrete and explicit problem*: by which we refer, of course, to the period’s discovery of existential risk as terrestrial life’s enveloping condition.

Like an insurance policy without a premium, foundationalism’s ancient security-system was too good to be true: for, just as a surfeit of rigidity is a form of fragility, an openness to risk is the very avenue of flourishing—as much as of failure—in epistemology as in economics. Modern intelligence, indeed, feeds upon its riskiness and attenuates without it: for it is the very channel of update and revision, as well as what makes us accept the *stakes* of our claims, or, alternately, makes us, in fact, *responsible* for them (thereby, impelling us toward their constant improvement). For, by formalizing a rigorous

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technical knowledge of jeopardy, human intelligence could first conceive of itself as ‘enterprise’: as that which exists solely through its persisting success. And so, in this late-coming competency, doxastic and aleatory construals of probabilistic risk reconvene, at the limit: in our globalized age, epistemic failing (in the sense of wrongheaded policymaking) fully scales toward existential failure. In other words, *what we think matters*. We either know ever better, or, potentially, never again.

6—TERMINALITY, 1660-1801

Computing odds of global catastrophe was all well and good; cosmically speaking, however, planetary destruction mattered little until the acceptance of terminality. We use ‘terminality’ to index a worldview—opposed to that of plenitude—that concedes inconsolable irreversibility and asymmetrical loss to physical processes and natural taxa.²⁸ Indeed, ‘human extinction’ only becomes a meaningful proposition insofar as it is accredited that life and sapience are not, themselves, the cosmic baseline from which everything else is mere divergence. In other words, due to modal convictions entrenched since antiquity, the default presumption was that if reasoning or organic life were decimated, *it would inevitably return*. Thus, ‘extinction’ simply could not be meaningfully articulated insofar as the absolute stakes that grant it its unique deontic significance were unavailable: for, from within the plenitudinarian framework, sapient life was not yet absolutely precarious nor, thereby, infinitely precious; and without terminality, and thus without axiological consequences, ‘extinction’ remained inert and inarticulable. We recall Lyell’s confidence in reappearing dinosaurs. Indeed, despite contributing so much to the birth of Bayesian statistics, Laplace remained a staunch frequentist in his

²⁸ N.B. even modern ‘de-extinction’ technologies will never *truly* reverse ecological terminus [Way, 2017; 12-3].

personal outlook, and, forecasts of world-decimating cometary strikes notwithstanding, he confidently predicted that civilization would simply re-emerge (and probably *already had*). Everything, he confided, would merely “be done again” [1799; ii.63-4].

6.1—a strange desolation, 1660-1760

In the 1720s, conviction of plenitude and modal equilibrium was so strong that global catastrophe seemed ‘trivial’ enough for Swift to lampoon his Laputans for their anxious actuarial forecasts of global disasters: fixated by various potential cometary or stellar cataclysms, they “never enjoy [...] peace of mind”, he quipped [2003; 153].²⁹ Swift’s efforts were supererogatory, however: the Royal Society projectors Swift was parodying had themselves already built conceptual safeguards into their proto-catastrophist theories, warding off entailment of terminus.

The very first scientific speculations upon possible species extinction scenarios, that is, ultimately resolve suggestion of terminality into a circuit of reversibility. Again, from their resolutely physico-theological seventeenth century outlook, existence simply is its justification, such that anything unjustifiable—such as an irreversible extinction, without *ratio essendi* in a guaranteed return or recompense—just simply could not be.³⁰

Hooke, that is, imagined that, prior to the previous world-order’s devastation, there had been a previous “learned Age”, of perhaps even greater knowledge than the present [1996; 328]. (Projecting

²⁹ Swift wouldn’t have liked the multiple academic institutions now dedicated to this very task—e.g. Oxford’s Future of Humanity Institute.

³⁰ The problem with an irreversibly absent species is that the species represents, thereafter, an eternally unfulfilled possibility—a gap that could be filled, but *just isn’t*, without further justifiability—thusly abrogating age-old presumption that existence is infinitely divisible into rational justifications for it.

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the ‘anxiety of influence’ between Ancients and Moderns onto geohistory, Hooke tantalizes himself with the unknown learnings of these prior civilizations.) Nonetheless, this schema presumes an “annihilated” humanity to persistently reappear and repopulate the desolate earth after each desecration.³¹ Destruction resolved into homeostatic cycle: a stratagem that will become familiar across the next half-century.

Halley and Newton, the latter having imagined “that this earth [be] burnt [and] no animals in it could live” [Genuth, 1997; 151], similarly tempered their views on catastrophe: recouping extrajudicial annihilation into an economy of utility, by insisting cometary impacts revived worlds, bringing new life. Halley ventured to predict the current “order of things be intirely destroyed” [Genuth, 1997; 165]; however, like Hooke, this merely would have equated to a *localized truncation* within an unending cycle of civilizations. A ‘punctuated eternalism’, therefore.

Hooke, however, having claimed that even the “Heavens themselves [suffer] Dissolution” [1996;435], had rallied the relatively novel idea that the superlunary realms suffer mutability. This, of course, stems from first observations of new-born stars and supernovas, dating from 1572 onwards [Greene, 1996; 15-37]. Galileo, in 1610, noted the first sunspots [Hoyt, 1997; 14], which he took to

³¹ Wordsworth’s 1805 *Prelude* contains a very similar scenario. Wordsworth prophesies global extinction, and then produces an impossible *Ubi sunt* for the lost “meditations of mankind” and “consecrated works of Bard and Sage”. Nonetheless, this is nested within a wider confidence that the “living Presence” would “subsist / Victorious”: one day “returning” like “kindlings [in] the morning”. Thus, though he may mourn lost intellectual labors, this is no ‘terminal extinction’. Interestingly, however, the episode is mediated—within a dream vision—by an “unknown tongue” emitted from a shell. Redfield [2013; 67] has recently argued this shell is in fact a fossil. Another “inorganic tongue”, therefore.

imply cosmic “corruption” [2010; 83]. Following from this, in 1686, Fontenelle imagined the prospect of *stellar extinction*:

These were suns which have lost their Light, & certainly there must be a strange Desolation in their Vortexes, and a general Mortality over all the Planets, for what can People do without a Sun?

[1687; 145-6]

Solar mutability surely signposts utter terminus; without replenishment, justification, or reversion.

What, indeed, can life do without a sun? For Fontenelle, however, this is not the end: when an old star dies, a new one is born, and worlds are repopulated with *exactly the same species*. “No species [can] totally perish”: a “New World” will appear to accommodate it [1688; 150-1].

Around the time that Locke confidently reiterated there were no “Chasms or gaps” in nature [1996; 197], Leibniz prognosticated that sunspots could “darken & eventually obscure” our sun [2008; 5]: as we know, however, this must be interpreted in light of his wider conviction that “nothing is fallow, or sterile, or dead in the universe” [1991; 26]. Within the Enlightenment’s new eternalist *Weltanschauung*, planets may well have become accidental, but life itself remained cosmically essential (thus essentially cosmic). Death is prohibited: only admitted as transitory interstice in planetary *panta rhei*.

By the 1740s, however, things were becoming more complex: the decade saw the dissemination, by polymath surgeon Claude-Nicholas Le Cat, of a new ‘Theory of the Earth’, positing the now-familiar cycle of “ruin and renovation”. Like Hooke and Halley prior, Le Cat employed this to explain the various fossil *incognita* being unearthed contemporaneously throughout the New World (some of which—later identified as mammoth bones—had, by this time, made their way to Buffon for inspection). Within the contemporary climate, Le Cat was conspicuously unclear, however, on whether humans themselves would return after the next world-collapse. In 1750 (two years after Montesquieu

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reiterated his depopulation hypothesis in *L'Esprit des loix* [1989; 439]), a shocked reviewer for the *Nouveau magasin François* picked up on Le Cat's equivocation, demanding to know whether "earth shall be re-peopled with new inhabitants" after any future world-collapse [anon., 1750; 384]. In reply, Le Cat dodged the reviewer's accusation of departing from orthodoxy (comparing himself to Galileo and Copernicus in the process), but not without wryly musing—with graveside smile—that

There are already a sufficient number of animals and men buried in the earth to gratify the curiosity of the new inhabitants of the new world, if there be any.
[anon., 1750; 384]

The eternalist cycle was beginning to unfurl: 'a strange desolation in its vortex'. Suitably, the reviewer had compared Le Cat's theorisations to the highly heterodox projections of Benoît de Maillet [anon., 1750; 380].

Having circulated via coterie since the 1720s (reaching publication only in 1748), de Maillet's singular *Telliamed*—a strange superposition of scientific backwardness and prescience—recounts a neptunist, proto-evolutionary and quasi-Cartesian geogony. De Maillet extended terrestrial history into the *billions* of years (decades before Buffon dared an expanse of 75,000). As with Fontenelle, a cosmic-scale cycle of stellar and planetary renovation and dissolution is projected, and, in perfect Enlightenment plenitudinarian mode, organic and rational species are assumed to ineluctably arise on each successive planet. Yet, the guarantees of renovation were becoming increasingly protracted and strained.

The *Telliamed*, that is, pictures a far-flung future, beholden to the "Extinction of our Sun" [1750; 215].³² Here, de Maillet, relentlessly eccentric, prognoses various dire scenarios: if the glowering sun

³² With this, we note the rise, within Koselleck's "*Sattelzeit*", of 'future fiction' [Alkon, 1987], and its importance to wider expression of X-risk: along with political revolution, philosophical critique, and

incinerates the oceans, and “if the Destruction of the Human Race is to happen by a total Exhaustion of the Waters”, then mankind will industriously irrigate the entire planet, digging “profound Valleys” in order to extract and protect “Fertility” [214]; otherwise, if the planet’s oceans instead *rise* as stellar “Extinction approaches” and evaporation dwindles, thus threatening “Inhabitants of the Earth [with] total Submersion”, these desperate final humans will “build large Vessels, [with] Flocks and necessary Provisions” where they will await the “Total Extinction of the Sun” [214-5]. Here, many decades before Byron or MWS, we find the *first last men*. Indeed, *Telliamed*’s images of worldwide geoengineering perhaps represent the first projections of planetary-scale X-risk mitigation: continuing into Grainville’s picturing of terraforming “engines” attempting to extract diminishing nutrition from a collapsing biosphere [2002; 46-7], and even into Byron’s 1822 prospection of future humanity averting incoming comets by “means of steam” and ballistic defence systems [Medwin, 1824; 226-8].³³

To return to the de Maillet, he astonishingly does not quite let humanity perish with our sun. He conjectures Earth floating free through void space—deorbited and unanchored—whilst claiming that it may just enter the gravity well of a new star, whilst envisioning this miracle giving the denizens of our wandering planet “hope” against “total Extinction of Mankind” [215]. Mothership Earth here becomes a precarious arc, which, in turn, implies sensitivity to the cosmos as a sea of risk: thus, though determined to avert it—to find a ‘way out or round or through’ [Wells, 1945; 15]—*Telliamed* thereby stresses growing responsivity to the cosmos’s oceanic threat and longterm likelihood of terminus.

capitalist prognostic, all these developments are downstream of wider expansions and sophistications of our modal notions; catalyzed by and catalyzing of a winnowing of ‘total possibility’ from horizons of ‘actual experience’ (cf. Chap.4).

³³ Potential for ‘unintended consequences’ of geoengineering is considered in contemporary X-risk literature [Torres, 2017; 90-3].

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Nonetheless, in spite of this, sapient vitality remains for de Maillet cosmic baseline, from which extermination can only be an erring lapse: even if humanity perishes on its unmoored ‘arc’, rationality does not die because rational denizens are the cosmos’s default and not a deviation. One finds similar presumptions in Diderot. The blind mathematician of *Lettre sur les aveugles* asks:

Why should I not affirm of worlds what I believe of animals? How many crippled and deficient worlds have dissipated themselves [in] distant spaces[?]

[1749; 123]

This statement of dissipation, however, is permissible only within a larger framework of recompense: Diderot makes sure to note that, for every dissipation, there is—“at every moment”—conciliatory reformation. The universe may be infinitely chaotic; infinity, however, never shrinks nor grows. Infinite chaos is just maximal plenitude once again. For, if the universe is *maximally* chaotic (i.e. expresses its chaos fully “at every moment”), then any assertion, no matter how unjustified, will mindlessly be realised: thus, it is a reconfiguration of correspondence and foundation, just one that submerges justificatory reason within maximally mindless being rather than subordinating autonomous being to maximally jurisprudential rationality. A cradle of chaos remains a cradle nonetheless.

This is why Blumenberg [1983; 181-2] writes of Epicureanism merely ‘neutralising’ inborn correspondence between man and macrocosm (rather than abolishing such congenital connectivity entirely). Diderot, indeed, appends the above by alluding to Lucretius’s prior theorisations regarding the successive destructions of “imperfect beings” since the “birth of things” [2007; 174]. That is, even though his first century BC *De Rerum Natura* almost certainly refers to the weeding out of aberrational ‘monstrous births’ as opposed to anything like what we now mean by ‘species extinction’, Lucretius is still sometimes cited as an ancient discoverer of extinction [Mayor, 2000; 216]. This misguided intellectual historical thesis became popular during the nineteenth century: for, whereas Creech’s 1682

translation of Lucretius encouraged solely a teratological interpretation of the passage in question by glossing it with the term “ugly Birth[s]” [1682; 165], John Mason Good’s heavily annotated 1805 edition goes into great detail retroactively legitimating Lucretius as Buffon or Cuvier’s progenitor in endorsing species extirpations [1805; ii.342-5]. Good’s reading is opportunistic, however: his editorial goal evidently to project modern science and politics onto Epicureanism [Vicario, 2007; 121-7], by way of irenic and sometimes forceful retrodiction.³⁴ To claim Lucretius as grasping *terminality* is totally misleading (even despite his sometimes influential depiction of an ‘aging world’ [Lucretius, 2007; 215], likewise anachronized by Good [1805; ii.361-3]). Put simply, Lucretius’s *kosmos*, as explained above, is perfectly plenitudinarian. Infinity, indeed, is perfectly compatible—indeed, uniquely compatible—with plenitude.³⁵ “[N]othing in creation is the only one”, Lucretius intoned [2007; 68]; thus, nothing can truly die. Put briefly, within any such system, all that our modal terms can express is global correspondences between our conceptual framework and the infinitely full universe, such that one cannot at all gain traction upon the corrigibility—and thus precarity—of the framework itself. Concepts, in other words, become cosmically necessitous. This crushing claustrophobia of infinitude not only proscribes any genuine advent or novelty, it also vetoes genuine cessation: thus, it ironically licenses utmost irresponsibility via trivializing existential stakes.³⁶

³⁴ Significantly, MWS and PBS ‘owned a copy of Good’s translation’ and were deeply influenced by it [Vicario, 2007; 121].

³⁵ The allegiance persists today: in modal realism in metaphysics [Lewis, 1986], or multiverse hypotheses [Tegmark, 2009] and Many-Worlds interpretations in physics [Rubenstein, 2014].

³⁶ The same problem plagues philosophies of becoming (such as Schellingean *Naturphilosophie* or Lamarckian *transformisme*) which simply ‘temporalize’ plenitude [Gode-von Aesch, 1941]. For Lamarck, species constantly *change* into other species, they never *disappear* without progeny [Gould, 2002; 178]. There can be no ‘net loss’. Philosophies of becoming, moreover, renew epistemic foundationalism by way of overflowing difference: which, like Schelling’s “groundless ground”,

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Diderot encapsulates this ‘trivialization’ perfectly. In this “immense ocean of matter”:

Everything changes, everything passes away. Only the totality remains. The world begins and ends without ceasing. [...] It's never been anything else and never will be anything else.

[1966; 174]

Lucretian prognoses on dying worlds remain fatal only parochially: inhabited worlds dissipate only to be replaced. Mid-century cosmology was rife with this pernicious presumption. Astronomer Thomas Wright, in 1750, espied infinite “final and general Doomsdays” across the heavens: the “Catastrophy of a World, such as ours [and] even the total Dissolution of a System of Worlds” may be as frequent as “Birth-Days or Mortality [upon] this Earth” [1750; 76]. He even presaged Lalande, Laplace and Olbers in suggesting “the end of ye earth might [be] certainly predicted” by computing cometary paths [1968; 32]. That “Comets are capable of destroying Worlds” is undoubtable, he professed [1968; 42]. Nonetheless, he maintained impactors satisfy ultimately revivifying roles, underpinning cosmological cycles of renovation.

Five years subsequent, a decidedly pre-critical Kant, in his *Allgemeine Naturgeschichte*, scaled this yet further. Casting the cycle wider than ever before, he wrested it onto entire star clusters, picturing a “Phoenix of nature, which burns itself only [to] revive again” throughout all “infinity” [2012b; 272]. “We ought not lament the perishing of a world as a real loss of Nature”, he impressed:

declares all assertions—no matter how irrational or arrogated—ultimately correspondent by way of the mindless maximalism of infinite becomings. (Overflowing difference licenses a blank cheque for irresponsible thoughts: a radical democracy of thought is, in fact, kakocracy.) Ultimately, plenitude works to naturalise modal vocabulary—globally reducing modal to non-modal terms—such that all they *can* express is adequacies between concepts and being (rather than any divergence, autonomy, or contingency between the two). Naturalising our cognitive framework in this *holus-bolus* fashion repatriates cognition—even if qualified as ‘germinal’ or ‘preconscious’—as maximally necessary and congenital within nature.

[she] proves her riches by a sort of prodigality which, while certain parts pay their tribute to mortality, maintains itself unimpaired by numberless new generations.

[1900; 150]

It takes a supreme faith in plenitude to license this statement. “Man [is] himself not excepted from this law”, Kant decreed: earth-shuddering cataclysms have “[swept] whole peoples from the earth; but it does not appear that nature has thereby suffered any damage” [1900; 150]. Significantly, Kant then quotes the same line from Pope that PBS and Richter would later utilise in an *entirely* less optimist manner: “now a bubble burst, and now a world” [1900; 150]. Only from within plenitude’s cosmic insurance scheme can planet-scale “catastrophy” be compared to a bubble bursting without the most sadistic morbidity (an implication later weaponized by PBS and Richter in their reworking of this image). Earthly humans may perish, but since beings like us are universal, nature suffers no axiological “damage”. Diderot, again, demonstrates this arrogance perfectly. In 1769, a year after the total extermination of the Aleutian sea-cow [Sauer, 1802; 181], Diderot is said to have reported, during a discussion at the *coterie holbachique*, that our species will “undergo the same fate” as those others already deceased. Asked, however, whether *Homo sapiens* would reappear during another stellar cycle, Diderot emphatically answered: “yes”. Evolution would be re-run:

At first, I don’t know what; and then at the end of several hundreds of millions of years of I-don’t-know-whats, the biped animal who carries the name man.

[Kors, 1976; 99]

Here, then, is no extinction for us. In absence of theory-level articulation of terminality, the annihilation of *Homo sapiens* means nothing; sapience had to be acknowledged as astronomically local before extinction gained astronomic stakes; for, only an absence of terminalism could license Kant’s world-crushing flippancy or Diderot’s faith in secular reincarnation.

6.2—buffon’s heat-death, 1754-1812

Relating every destruction to its consequent replenishment, plenitude sequesters ‘death’—balkanizing it and domesticating it—as temporary latency or parochial locality relative to a global maximum of fully justifiable existence. By making ‘death’ constitutively relational (to the ‘life’ that it removes or is replaced by), this framework consequently prevented receptivity to the autonomous and independent reality of nature’s abiotic majority: one simply could not ‘see’ the brute fact of this inorganic realm severed from all prudential utility. With the collapse of plenitudinarian frameworks, however, came the repudiation of presumption that naked existence holds inherent contentfulness for evaluative cognition (i.e. the final loss of the sense that mere ‘existence’ was, in-and-of-itself, a morally informative category and, conterminously, that naked existence—without any conceptual mediation—could be meaningful). With this framework-level extrication (of contentfulness and existence) came eventual receptivity to observation-level reports of the autonomy of the inorganic world and, thereby, conduciveness to conceive of an abiotic terminus severed from all relationality to life or mind: a ‘death’ surpassing all possession, epitaph, or commemoration; unchained from our “never-ending, still-beginning” witness and moral adjudication; and, most importantly, entirely disentangled from any sense of eventual recompense or return.

We see glimmerings of this already in Kant’s 1754 essay considering the “ageing” Earth (later translated by De Quincey [2003b]). Here, Kant discusses whether “destruction is the last link” in our “chain of events”. He models various pathways of “decay”: such as, for example, eventual fluvial absorption of all soil-bound nutrients. “[P]roductivity is gradually declining”, he writes, the world “slowly becoming deserted and less populous” [2012a; 169]. Despite imagining various routes to this

finality, the model, throughout, is essentially dissipative. Importantly, he claims “contingencies” such as the exact *mechanism* of this exhaustion are no more pertinent to our topic than “earthquakes” are to “consideration of the ways in which a building ages” [2012a; 181]. In this, a subtle yet important distinction is made: Kant implies that dissolution is fully internal to nature’s own logic and, consequently, it is only the ‘mechanism’ of collapse that is accidental or contingent, whereas dissipation itself remains unavoidable. The first *incontrovertible* accession of physical time-asymmetry, however, came only with Buffon and Bailly.

In 1757, Samuel Johnson strongly inveighed against plenitude, highlighting “infinite Vacuities”, whilst proclaiming “any order of being may sink into nihility” [1984; 531]. Across the Atlantic, Benjamin Franklin (soon taking interest in the *incognita* being excavated across the frontier and theorizing their extinctions caused by orbital shifts) imagined that a cometary strike “might instantly beat [Earth] to pieces, or carry it off out the Planetary System”, thereby settling “[a]ll the Disputes [of] Europe [in] a Moment” [1976; 176]. By November 1765, Haller wrote to Bonnet pronouncing “a very dangerous tendency” in natural philosophy [Roger, 1997; 344]. He was referring, of course, to Buffon. The towering French naturalist—in the space between 1749 and 1761—had gone, that is, from accepting the extirpation of unassuming marine invertebrates [Cohen, 1994; 98] all the way to assenting the passing of the “prodigious mammoth” [Greene, 1996; 94]. Haller had seen nothing yet, however. Across the next few years, Buffon constructed a universal history that would first inject ineluctable directionality into the cosmos.

As mentioned in Chap.1, Buffon hypothesized planets were formed from solar ejecta that, having consolidated into spheroids in space, later cooled: thereafter forming an outer-shell, or crust, wrapped

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around a molten core. This model led Buffon to conclude that, at some future point, Earth would lose *all* of its central thermic energy, promptly refrigerating, wiping out the biosphere. Notably, his theories contain no eternalist conciliation envisaging life popping up elsewhere, and his vision remains resolutely terminal. (This, indeed, was the “sublime but gloomy theory” that had bewitched PBS.) Chillingly, Buffon’s calculations gave 168,123 years until this *irreversible end of all terrestrial activity* [Haber, 1959; 118]. Though reaching this prognosis in 1767, it was not published until 1778’s *Époques de la Nature* [2018]. Nonetheless, as Brush [1996; 77] points out, from this theorisation ‘it was but a short step to conjecture that all bodies in the universe are cooling off and will eventually become too cold to support life’. Indeed, this is necessarily an entailment of Buffon’s theory of planet-formation. In 1777, indeed, Bailly explicated exactly this. He surmised that all planets were at different stages of thermic dissipation (Jupiter remaining too hot for life; the moon already too cold) and he duly extrapolated toward a ‘final state’ which was ‘described as one of “equilibrium” where all motion has ceased’ [Brush, 1996; 77]. (Note that Bailly granted these theories visibility by inserting them into an epistolary exchange with an elderly Voltaire, subsequently published and widely read [Haber, 1959; 134-5].) Here, almost a century before Clausius named “entropy” in 1865, we have the first picturing of cosmic thermic terminus or heat-death.³⁷ In this, Buffon and Bailly broke with an entire history of Western thought going back all the way to Parmenides: instead of subordinating time to self-identical being, they first elucidated cosmic chronology as entropic asymmetry.

³⁷ Current physical eschatology forecasts this ‘Dark Era’ as $\approx 100^{100}$ years away [Adams, 2011; 104].

The invention of terminality was complete. Given Bailly's model, all organic life *will have died*. This, of course, includes sapient humanity. What's more, we may not even last this long. As early as 1761's volume of his *Histoire naturelle*, Buffon had entreated

Who can say, if the human species were annihilated, to which of the animals would the sceptre of the earth belong?

[1807-15; vi.27]

Whatever the case may be, whatever protraction or truncation of time we may enjoy, “the human species”, like any other ‘sceptred’ animal, lives on *borrowed time*. As H.G. Wells later agonized, ‘there is no way out or round or through’. The extrication of time from symmetry arrives, again, by way of the defeasance of the metaphysical model of “Being”, long foundationally considered as primordial correspondence with—and thus inherent responsivity to—epistemology's judicial demands and logical tautologies. Against the perennial presumption of timeless identity undergirding destructive time, Buffon's theory makes the entire planet into a clock. (Hence, PBS's imagining of alpine glaciers as the tractors of asymmetric time: overthrowing “limits of the dead and living world, / Never to be reclaim'd”.) Indeed, Buffon had performed rudimentary ‘analogical experiments’ to reach his predictions regarding the timeframe of refrigeration; heating small iron globes, acting as miniature planets, and measuring their cool-down durations; presupposing, thereby, an identity between thermic dissipation and cosmic chronometry. In Bailly's universal extrapolation, *nothing isn't an hourglass*. Turning the entire world into a thermal clock in his crude experiments, Buffon unwittingly expedites modernity's increasing liberation of horology from empirical horizons: time is not produced by objects; objects, *without exception*, are effluvia of time. (We note how this parallels Kant's delineation of a blank clock-time abstracted of *all* empirical substance [cf. Greenspan, 2000]: again, this arises from the wider de-semantification of nature, whereby—emancipated from all inborn qualitative property and

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intentional contentfulness—temporality, neutralized of all such objectifiable content, can stretch beyond the conditions of objectivation as such, or, in other words, outlast all meaning and qualia.)

Such conception was, simply, infeasible beforehand. Indeed, in 1632, Galileo had imagined to himself a sterile planet, amusing himself with its impossibility. “It is my opinion”, he wrote, “that the Earth is very noble” on account of its populousness,

and if [it] had been all one vast heap of sand, or a mass of Jasper, or [if, after the] Deluge, the waters freezing which covered it, it had continued an immense Globe of Christal, wherein nothing had ever grown, altered or changed, I should have esteemed it a lump of no benefit to the World, full of idleness, and in a word superfluous, and as if it had never been in nature; and should make the same difference in it, as between a living and dead creature

[1661; i.68]

Given age-old presumption that mere existence is justificatory warrant, and that thus ‘to be’ is ‘to be justified’, a hole in the tissue of justifications is tantamount to a hole within existence itself: and the chasm here is *the size of a planet*. To Galileo, such an egregious vacuum of value was ontically unthinkable. By contrast, nearly two centuries later, in 1811, Coleridge could idly daydream the following vaticination within the privacy of his notebooks:

Suppose the Earth gradually to approach nearer the Sun or to be scorched by a close Comet—& still rolling on—with Cities menless—Channels riverless—5 mile deep.

[*CN*; iii.4094]

Thomas Beddoes, likewise, could talk of the “great ruinous dream of broken worlds/ Tumbling through heaven”; of “bursten worlds”; of the “brazen pinions vast / Of planets ship-wrecked” [1935; 8]. From Byron, we are offered the vision of the “burning wreck of a demolish’d world / A wandering hell in the eternal space” [2008; 276]. Appropriately, in 1802, Olbers (the astronomer we encountered earlier concerning impactor probabilities) published his ‘planetary explosion hypothesis’ arguing that the Mars-Jupiter asteroid belt in fact constitutes the ruins of a shattered planet [Zach, 1802]. Not mere

extinct bivalve, nor even an absent mammoth or megatherium, this yawning gap in ‘natural order’ suggested vacua the size of entire planets perforating the ligature of justification [Cunningham, 2016; 115-126]. Thomas Wright had abduced such a hypothesis previously (deeming it most “probable” the Mars-Jupiter saltation houses the splinters of a desecrated world [1968; 42]) yet, in 1750, such conjectures made little headway; by the 1800s, however (following discoveries of Uranus—and of “planetkins” such as Ceres, Pallas, Juno and Vesta—which had destabilized old notions of the Solar System’s harmony) this “very romantic idea” of planetary explosion was widely canvassed, sending shockwaves throughout wider culture [Cunningham, 2017]. Poets wrote of

yon portentous wreck, ’twixt Mars and Jove
That rolls in fragments!—once a sister world—
[Willis, 1821; 68]

Godwin, particularly, was horrified at this “catastrophe” on our cosmic doorstep: “[h]ow does this correspond with the goodness of God, which will suffer no mass of matter in his creation unoccupied?” [1831; 432]. The plenitudinarian worldview was, slowly but surely, unravelling. Indeed, the question of “bursten worlds” was swiftly excoriated of all such moralistic entanglement: Joseph-Louis Lagrange, indeed, authored a paper [1812] mathematically modelling the ‘explosive power required to burst a planet’—assigning ‘numbers to the forces required’ [Cunningham, 2017; 4-18]. In 1813, Scottish poet Thomas Campbell asked William Herschel for his opinions on the matter; the great astronomer, in reply, affirmed “the universe was [by no means] secured [from] chance of sudden losses” [Campbell, 1850; ii.235]; we note that Campbell, within ten years, had written one of the first literary treatments of the ‘Last Man’ [1823]. Nonetheless, Herschel had pointed out to Campbell that, given the time it takes light to travel, many of the stars he was currently observing were likely already *long-extinct*. The year

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after this correspondence, Herschel revised his previously cyclical views, theorizing that the *entire galaxy* is a “kind of chronometer” (made legible by way of the progression of nebula clustering). Reading this gargantuan galactic timepiece “affords a proof”, Herschel reasoned, that the “past duration” of our stellar cluster “cannot [be] infinite” and, equally, “it cannot last forever” [2013; ii.541]. *Every object an hourglass.*

Looking upwards might be looking into the deep past, but—insofar as it is also looking out at an environing canopy of death—it may well also be looking into our long-term future. One gets this sense with Richter’s description of staring out into the cosmos’s “bottomless eye-socket” [1992; 182] and, similarly, with De Quincey’s chilling description of the Orion Nebula: glimpsed through the telescope as a gargantuan, eyeless “skull”. Indeed, the universe’s rictus is here directly compared to “Death” itself. De Quincey, that is, imbues this interstellar mass with a kind of sovereign recalcitrance to the “eyes of flesh”. Orion becomes a symbol for nature’s autarkic severance from judicial and organic interests. It hangs in “the frost” and “eternities of death”:

famous for the unexampled defiance with which it resisted all approaches
from the most potent of former telescopes; famous for its frightful magnitude and for
the frightful depth to which it is sunk in the abysses of the heavenly wilderness
[2003c; 403-4]

Gone is Fontenelle’s vision of outer-space as interminable petri-dish. Of course, the skull imagery isn’t just convenient or conventional: there is a clear sense in which one cannot look into this “frightful depth” without reflecting upon one’s measure of one’s own position as an intelligent observer in this (inhospitable) universe. Indeed, just as Malthus’s reasoning on geometric growth inferred it more probable that “premature death must in some shape or other visit the human race” (as an upward revision of ambient expectation for oncoming calamity, largely agnostic regarding the specific

mechanism of collapse [1992; 43]) so too is a similar inference undoubtedly encoded in De Quincey's passionate reaction to Orion. For, severed of synecdochally relating to some putative cosmic organism or noetic absolute, the organic observer—radically parochialized to our planet's "mouldy film"—cannot but reflect on her own precarity.³⁸ De Quincey's vignette beautifully captures this in an observation report, conveying visceral emotiveness.

In 1784, not long after Buffon's entropic reverie, Louis-Sebastian Mercier produced perhaps the first treatment of human extinction in literary prose. Within his *Mon bonnet de nuit*, the prolific chronicler of Parisian life (a 'connoisseur of catastrophe' [Schama, 1990; 198]) divulged a terminal vision of a nature "become old". Harking back to an old implication of Newton's, he imagines "mechanical laws" becoming "weakened" and "no longer so strictly bind[ing] the suns and world":

The sun leaving its orbit, would sink into the utmost depth of heaven, pale and obscure; and the earth pursuing an uncertain course would soon experience cold and darkness in both hemispheres.

[1785; i.23-4]

Looking back to Fontanelle and forward to Byron's 'Darkness', Mercier here also presages MWS's *Last Man*, projecting a wandering Earth become stagnant and pathogenic. "[C]ontagion would arise", and,

death would annihilate the human race, and the earth rambling in the void space, would exhibit a barren, depopulated aspect.

(One notes how strikingly prescient Montesquieu's 1721 talk of a "deserted" earth now seems.)

Mercier, importantly, proffers no "reignition" of the stellar corpse (as per de Maillet). The "rambling"

³⁸ We cannot but note that this late eighteenth century realization of space's emptiness provided one of the key conceptual components essential to later formulation of Fermi's Paradox. The universe's silence remains a core riddle arresting astrobiology and SETI [Ćirković, 2018].

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Earth becomes the realization of the Galilean nightmare—a *sterile world*. Mercier finishes the article thusly:

A rock is one hundred times more durable than a generation of men. [i.26]

Moreover, he underlines his “description” of utter extinction by claiming that

though dismal, [it] has an appearance of grandeur and majesty; the death of a sovereign who had a glorious reign, has something solemn in it; his tomb impresses respect, and engages our attention; the dissolution of the universe fills the mind with awe; and the extinction of the human race has less effect on us than that of a friend or a mother. [i.24]

Something interesting happens here. The crescendo of Mercier’s attempt to subsume extirpation within some economy of utility by invoking aesthetic categories established by ruin-pondering implodes upon itself in the last clause: having sequentially elicited legitimate affective responses—“respect”, “attention”, “awe”—Mercier’s attempted minting of extinction’s aesthetic value bottoms out, crashing into the utter absence of any affect. Human extinction, by definition, simply *would* have “less effect” than a family death. Unlike *Ruinenlust*, extinction is unassimilable into an economy of aesthetic utility, because it is severed from observational horizons. Played out here, it portends the ‘ruination’ of the very evaluative categories of the ‘ruin aesthetic’: there can be no terminal witness from which to recuperate didacticism or even affect. The ruin of empires is a continuation of history; human extinction forecloses the very possibility of history. And, interestingly, *in their malfunction*, these old metaphoric conventions for mediating and mitigating loss mutate into expressing brutally callous wastefulness. Having summoned “violent extremities” which “tend to the destruction of [nature’s] children”, Mercier speaks of

An entire globe, peopled with twelve hundred millions of sensible, thinking beings, [which] depend on the brutal action of the elements [and] Pope will answer, *a bubble of water bursts, a world destroyed*, are equal to the eye that sees all.

[1785; i.9-10]

In light of terminus, Pope's image becomes *infinitely sadistic* (as Mercier, Richter, and PBS variously exploit). Or, from within plenitude's own framework, brute existence, unbound from interminable identification with justification, becomes—to the very extent that it nakedly is—a gaping wound in the tissue of justice: this is the final stage in the rending of rationality from existence, or, value from fact. Indeed, we mentioned that the plenitudinarian framework necessarily obsolesced *from within*: for, where existence is no longer justifiable yet still considered inherently moral, its 'over-abundance' mutates from bounteous generosity into gargantuan libertine wanton. Enter de Sade. Indeed, the Marquis embodies the end-stage step—the final autoimmunity—of the plenistic framework's self-exasperating senescence. In his hands, terminal extinction, as soon as it was rendered expressible, became libidinized.

6.3—sadean omnicide, 1795-1801

In 1795, one year before discovery of the first *Megalonyx* [Jefferson, 1799], Sade divulged his utterly devastating *La philosophie dans le boudoir*. Therein, the Marquis titillates us with the idea that the “obliteration” of our “entire world” would in nowise afflict “Nature”:

the stupid pride of man, who believes everything created for him, would be dashed indeed, after the total extinction of the human species, were it to be seen that nothing in Nature had changed, and that the stars' flight had not for that been retarded.

[2007; 333]

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Aside from some inklings in d'Holbach, this is likely the first statement of its kind (i.e. using extinction to attack human hubris).³⁹ Foucault has already compared the 'event' of Sade with the 'event' of Cuvier [2005; 303]. Both men, in their own way, desecrated the Great Chain of Being. Certainly, Sade wholeheartedly embraced the concept of extinction. For example, in a protracted argument for the delectations of various outlawed sex acts, Sade violently dovetails into a premonition upon human extinction. It is worth quoting at length:

the sodomite and Lesbian serve [Nature] by stubbornly abstaining from a conjunction whose resultant progeniture can be nothing but irksome to her. Let us make no mistake about it, this propagation was never one of her laws, nothing she ever demanded of us, but at the very most something she tolerated; I have told you so. Why! what difference would it make to her were the race of men entirely to be extinguished upon earth, annihilated! she laughs at our pride when we persuade ourselves all would be over and done with were the misfortune to occur! Why, she would simply fail to notice it. Do you fancy races have not already become extinct? Buffon counts several of them perished, and Nature, struck dumb by a so precious loss, doesn't so much as murmur! The entire species might be wiped out and the air would not be the less pure for it, nor the Star less brilliant, nor the universe's march less exact. What idiocy it is to think that our kind is so useful to the world that he who might not labour to propagate it or he who might disturb this propagation would necessarily become a criminal!

[2007; 276]

The crippling *realism* of extinction is here enacted—akin to De Quincey's "unexampled defiance" of the universe's shocking autonomy from human jurisdiction. In this key passage it is unveiled that

³⁹ Holbach wrote of "[t]he human species" that it "is a production peculiar to our sphere [...] that, when this position may happen to change, the human species will, of consequence, either be changed or will be obliged to disappear". This is because "man" would no longer be able to "co-order himself with the whole" as that which "enable[s] him to subsist". This inbuilt 'co-ordering' is, Holbach reveals, "not only what furnishes [man] with the idea of order, but also makes him exclaim, *Whatever is, is right*, whilst everything is only that which it can be, and the whole is necessarily what it is" [1795-6; i.146-7]. Holbach here sagaciously links plenitudinarian presumption that *the actual exhausts the possible* ("everything is only that which it can be") with the existential cradle proffered for human reason by *identification of jurisprudence and ontology* ("*Whatever is, is right*"). The pair are flipsides, converging to insure and insulate rationality against precarity (both existential and assertorial, practical and theoretic).

Sadean sexuality is precisely consequent upon Sade's natural philosophy—the one is inseparable from the other—inasmuch as useless orgasm is revealed, and justified, as a mere subtype of generic cosmic terminus.

Writing just prior to Cuvier's game-changing 1796 lecture, Sade instead cites Buffon as authority; nonetheless, declaring untrammelled “obliteration [of] entire worlds” [2007; 332], Sade already intuited the outlines of Cuvierian catastrophism (though De Luc [Rudwick, 2005; 307] and Blumenbach [1790] had already posited similar models). Collapsing sexual paroxysm onto geohistorical cataclysm—orgasm onto extinction—Sade here modulates bedroom politics through his natural philosophy of generalized terminus. This unravels as vicious assaults upon the natalist demographic policymaking of the *ancien régime* [cf. Tuttle, 2010]. Heteronormative notions of procreation—arising, indeed, as an extension of plenitude to sexuality—have traditionally been braced by the prejudice that, as existence is ‘better’ than non-existence, sex should only ever be reproductive (it should ‘create’): as such, homosexuality was long related to death and negation, because the homosexual act ends in ‘mere terminus’.

In the above quotation, Sade eviscerates this argument, instead cosmically vindicating “sodomy”: for, when nature is no longer ‘essence’ but ‘expenditure’, then the much-maligned wastefulness of the nonprocreative act suddenly becomes the most “*natural*” of all acts. Yet, despite inverting and exasperating its internal logic, Sade conspicuously remains utterly within the plenitudinarian *Weltanschauung*: his sacral sexuality is predicated upon naturalistic fallacy as much as plenistic pronatalism was (insofar as it justifies ‘immoral’ acts by reference to putatively ‘immoral’ nature) and this is because it is only whilst remaining firmly *within* plenitude's foundationalist framework that

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nature's severance from jurisprudence takes on any juridical weight whatsoever. It is by now cliché to point out that 'libertinism' requires 'law' as much as 'transgression' requires 'taboo'. Yet it is no less true that Sade's posturing of stepping entirely beyond Old Regime morality is just that: *posturing*. This is key because the 'event' of Sade perfectly pinpoints and dramatizes the inner-collapse of plenitude via conceptual 'reoccupation' [Halimi, 2007; 115]. He does not extricate himself from this framework but represents its terminal exasperation. Accordingly, his is a Principle of the Plenitude of Prodigality:

Destruction being one of the chief laws of Nature, nothing that destroys can be criminal; how might an action which so well serves Nature ever be outrageous to her?

[237-8]

Sade's cosmic libertinism still considers nature legalistically (perhaps especially so, for it volatizes his tastes) because only in the ruins of the assumption that 'to be' is 'to be just' can the total extinction of legality become lionized as nature's "chief law". This marks a climax of auto-exasperating self-obsolence for classical metaphysics and its presumptions of existence's inborn epistemic-normative contentfulness: the 'death of metaphysics' is here incoherently suggested—from within what is still a thoroughly metaphysical outlook—as the 'metaphysics of death', enacted here as the cathexis of human extinction. With this, Sade inflates 'extinction' cosmologically: merely transplanting the idealist's intellectual absolute with the irrational termini of stellar ejaculations. Indeed, given the prudential assumptions of his age, if the sun's fuel-reserve isn't infinite or replenishing (instead being finite and asymmetric) then stellar refulgence becomes reconfigured as a massive, prodigious waste of energy: *much like the sodomite's climax*. The sun is protracted orgasm; another way of calling it a "chronometer", perhaps. (One here recalls PBS's georevolutionary imagery of the *ignis centralis* and its troubling proximity to Milton's image of rotting, profligate "star-bestud" deeps.) Accordingly, Sade's

fictions (respecting no fact/value distinction, *in precisely identical fashion* to the moralistic regime he was railing against) hypostatizes libertine sexual values as active throughout non-conceptual nature: collapsing distinction between, orgasmic, socio-political, biotic, geophysical, solar and cosmic termini. With this, Sade sexualised the Buffonian “tendency” in natural history by naturalizing the Sadean tendency in sexuality. In the bitter end, all homeostatic reciprocities haemorrhage into filthy unilateral exchange: “propagation is no wise the objective of Nature” [2007; 248]. Thus, Sade, just as prescriptive as the moral establishment he was ‘escaping’ from, demands that we invest in his ‘general economy’ of cosmological orgy [Bataille, 1988-93]: engaging in luxuriant wastefulness and impelling, thereby, the inevitable annihilation of humanity at the hands of sovereign nature. Again and again throughout his blasphemous novel, his characters cry out that

**by means of this system you are going to be led to prove that totally to
extinguish the human race would be nothing but to render Nature a service**
[2007; 230]

In this, human omnicide becomes the highest—most righteous—expression of sovereign nature’s *universal mortido*, or, self-destroying drive. By the time of *Juliette*, in 1797-1801, Sade’s lethal thanaticism and anti-natalist mantras had reached their peak:

**the propagation of our species therewith becomes the foulest of all crimes,
and nothing would be more desirable than the total extinction of humankind.**
[1968; 373]

We have been arguing that full articulation of human extinction arises from the evacuation of inherent epistemic contents (propositional conventions, qualitative properties, semantic architectures, normative warrants, etc.) from naked existence, an extrication which arose necessarily from slowly disentangling the orders of justification and of existence, or, normative warrants and ontic facts. Sensitivity to, and grasp of, norms is requisite for any description of any objective fact to count as

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such—insofar as empirical description involves notions of ‘correctness’, and thus ability to expressively distinguish apposite and inapposite usages—yet these ‘norms’, despite being utterly *necessary* for our description of natural objects, are themselves *not* natural objects. Values are not facts. Nonetheless, it was a long-running assumption of Western metaphysics (until Kant, as we explore in Chap.4) to misconstrue these non-descriptive features (i.e. the semantic and judicial conventions that alone make description possible) as themselves straightforwardly descriptive or correspondent objects, thusly hypostatizing our normative structures as congenital features of factitious reality. Aside from persistently engendering naturalistic fallacies and ‘physico-theodical’ extravagances such as the PoP, this outlook—in presuming existence is an inherently *morally* meaningful predicate—could not produce propositions upon the potential foreclosure of moral endeavours within existence. Hence, no human extinction. What is important about Sade, as exemplar case within this ‘disentanglement’, is that (despite his posturing as ‘free’ of morality) his cosmic libertinage likewise fails entirely to extricate judicial content from factitious reality and, thus, he cannot properly incorporate a prospective terminus of value. Or, foundation in sadism remains a foundation once again. We see this, in Sade’s ontologisation of the ultimately deontic category of freedom (similar to Schelling, therefore): in his ascriptions of a sovereign and “omnipotent” nature. (This is, of course, why his is ultimately an *atheology* rather than *atheism*.) And, indeed, it follows that if destruction is maximally righteous, then there *must* always be something to destroy: the energumen of collapse desires that collapsing never ends. And so, despite appearing to endorse ‘terminality’, Sade enjoins his own form of resurrection, smuggling underlying symmetry back into his nested termini. Imagining our “species [being] blotted out of existence”, he exclaims that “the whole extirpation of [our] breed would, by returning to Nature

the creative faculty she has entrusted to us, reinvigorate her”, and, thus, he insures that “new constructions, wrought by her hand” would eventually replace us “were our species to be destroyed absolutely” [2007; 230]. As Laplace earlier confided, everything must “be done again”. If you reify destruction as a *value* autochthonous to existence—even if as a negative valuation—then the destruction of value can *never truly terminate*. Here, then, is no true extinction!

Ultimately, though Sade is perhaps one of the first people to truly and deeply engage with the prospect of human extinction, he cannot be said to do so coherently. His entire system rests on tortuous paradox: deeply respecting the law, he inherits age-old metaphysical intuition that ‘to be’ is ‘to be just’ and takes this mandate to heart; yet, simultaneously, he sees empirical existences clearly exceeding righteous judiciary, indiscriminately and with impunity; by holding these two contradictory claims, i.e. that being must be identical with justice and *also* that being is maximally injudicious, he is consequently forced to concede that ‘being’ is simultaneously also ‘nihilty’. He places this paradoxical intertwinement of negation and existence at the base of his system [Blanchot, 2007; 58]. Tarrying with such founding contradiction may be ‘libidinally hydraulic’ (in the sense that it provokes the entire hedonic system of sadism to unfurl through pulsional transvaluation), but it is epistemologically redundant and, what’s more, simply recrudesces the metaphysical naïvetes and dogmatisms of the old-regime worldview it so desperately advertises itself as leaving behind: despite protestations of nihilism, Sadeanism is just genuflection to the maximal positivity of metaphysical “Being” once again; for, similar to Schelling’s “*Ungrund*”, the submission of discriminating reason to maximally irresponsible existence is just as much a cradle of correspondence as prior subordination of factitious existence to maximum jurisprudence. Though expressed now through a cognitive undercroft of the pulsions, appetitions, and

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elicit drives of overflowing existence, this is a foundation and pleroma all over again. In this sense, celebrating the epistemic irresponsibility of unconscious desire is, rather than somehow liberating, exactly as circumspect and risk-averse as the theodical solemnities such systems clamour to escape from. Maximalising qualitative difference—even if it is ultimately nociceptive—insulates qualitative content from inexistence. Sadism, strangely enough, remains an insurance scheme.

7—CONCLUSION

Sade—censored and clandestine—may seem an isolated case. Nonetheless, as Foucault reiterated [2005; 303], Sade was just an eruption of wider tendencies. He refused to differentiate ‘living’ from ‘dying’ at the cosmic level. For him, living is always a form of dying: the latter refuses to distinguish itself from the former. Excess of vitality consequently becomes exquisite collapse. Strange though it is, this idea also represents the conceptual kernel of Malthus’s *Essay* (published within three years of Sade’s *Boudoir*). For, where there is a finitude of fecundity in nature, famine (as internal limit-case of the finitely fecund) is rendered immanent to what is natural. Long-held moral distinctions between ‘life’ and ‘death’ thereby collapse. Dying, once hideously unnatural, is naturalised. The age-old connective tissues binding normativity and nature yield under stress: where nature had long been considered as living essence, and essence operated legalistically to identify juridical warrant maximally with existing existence, terminus had previously been expelled—*qua* unjustifiable and unjust—and relegated as accidental or epiphenomenal relative to life’s global maximum. With Malthus and Sade, contrarily, collapse was admitted as essential constant of life’s dynamics. *Too much life results in death*. Malthus, accordingly, draws the comparison between “the mortality of man on earth” and the allometry of a flower: “the reason why plants and animals cannot increase indefinitely in size is that they would fall by

their own weight” [1992; 53]. (We recall *Frankenstein*’s threat of geometric growth, here.) Extrapolating this upward, the kill-switches of extinction events (of “epidemics”, “pestilence”, and “gigantic inevitable famine”) are revealed as unquestionably embedded within nature’s widest dynamics.

However, as we have seen, Sade failed entirely to extricate deontology and ontology, such that (falling again into pleroma’s comfortable trivializations) he was unable to self-articulate the full stakes and, thus, deontic implications of existential precarity. This articulation only became available through Kant’s critical philosophy (cf. Chap.4). And yet, despite the chasm separating their worldviews, Kant (as we saw in the introduction) ended up exhorting his own version of omnicide: doing so, it should be no surprise, for altogether more coherent and legitimate reasons; which, of course, makes his reasoning immediately more concerning *vis-à-vis* Sadean melodrama.

By now, casting Kant and Sade as bedfellows is somewhat trite, the long-held consensus being that the Sage of Königsberg also plays upon the knife-edge of limit: for Kant, this concerns reason’s entitlements; for Sade, it concerns sexual transgression. Kant’s ‘Analytic of the Sublime’ famously presents what Hamacher called ‘transcendental masochism’ [1999; 277], wherein it is only in the utter laceration and quaking collapse of sensibility’s expediencies that we rebound and redound upon pure reason’s supererogations. Yet, at the limit, this supererogatory drive shuttles towards the separability, through supercession, of the rational project relative to its (currently) human host. In other words, if the human organism remains indefinitely incarcerated by merely exigent desires (selfishness, dishonesty, etc.) then the only possible triumph for uncompromising “*Aufklärung*” is *humanity’s replacement*. Rationality’s human mouthpiece might be only incidental. Recalling’s MWS’s

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intraspecific antagonism regarding *Frankenstein's* “race of devils”, we hereby note that *Homo sapiens* itself might be the very ‘behavioural sink’, or “race of devils”, in question: indeed, in his *Perpetual Peace*, Kant [1902-; viii.366] fortuitously selected the exact German equivalent of MWS’s phraseology, insinuating that humanity is, in fact, the irredeemable “*Volk von Teufeln*” (‘race of devils’). Again, it is through our “radical evil” that Kant professes “perpetual peace” may only be achieved in humanity’s “vast graveyard”: leading to his later conviction that *Homo sapiens* exists only to be surpassed by a “higher level” of intelligent agent. Thus, one may title Kant ‘masochist’ if one will, but his motivations here—far from carnal—are coldly and consistently rational: suppressing even the alluring parochialism of species-solidarity in constancy with the resolute duties of reason, up to, and including, the supersedure of our global project to better actors; whereby, the “*Bestimmung*” of rationalist deontology becomes entirely detachable from the mere ontic accident of our species-specific germline. One cannot help but think, here, of the dilemmas crowding our own near-term horizon—simultaneously of urgent ethical and existential import [Bostrom, 2014]—relative to the ever-ramifying global apparatus of machine intelligence.

Here, then, is a very rational end of the world.

‘THE BEST CRUCIBLE IS THE MIND’: on CATASTROPHES, DUMPLINGS, and MODEL-BASED REASONING

We carry a world within us while we think; we posit or create a world without us while we speak.

—Lorenz Oken

Well, not experiments exactly. We do not profess to construct planets.

—Lewis Carroll

Our brain is an ontological engine.

—Thomas Metzinger

0—INTRODUCTION

We have already encountered science’s ‘theoretical entities’. They are such objects, Brandom informs us [2014; 16], as are reportable solely via inferences as opposed to direct observations. The philosophical standing of such objects is key for articulating extinction, insofar as positing objects beyond all possible experience is dependent upon prior awareness that human experience is not absolute. Thusly keyed into sensitization to the limits of naked observation, this is why we have to *artificialize* in order to *naturalize*. In other words, it is why science—in explaining the natural world—is itself increasingly artefactual and theoretical (relying on manufactured models, cognitive prosthetics, and unobservable entities). Forming the current chapter’s focus, this issue impinges entirely upon the emergence of the final scientific vocabulary requisite to the eighteenth century discovery of X-risk: *geology*. For, aside from providing the ground-level objective terminologies to describe natural history as utterly surpassing human history, the founding debates of the field revolved around precisely these theory-level issues: they were, indeed, occasioned entirely by the ongoing evacuation of phenomenal contents from independent existence. For, precisely due to prehistory’s severance from all observability,

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we must rely on the ‘artifice’ of theoretical inference in order to make sense of the deep past; and yet, insofar as the very postulation of an anteorganic past commits us to extricating such discursive content from autonomous nature, the very methodological position of ‘the theoretical’ became moot. Both major schools of geology reacted incorrectly (yet informatively so). Uniformitarianism sought to excise all unobservable entities and postulates, yet, in so doing, reified the limits of observation (culling mind-independence and historicity thereby, whilst engendering their homeostatic vision and sublation of terminus). Catastrophism, contrarily, admitted of unobservable objects but *only* insofar as they are ‘immediately attested’ by empirical data (though we have already seen how utterly nothing in this process is ‘immediate’ or ‘pure’) and, thus, only admitted such objects insofar as they were, accordingly, isolated from the wider theoretical-inferential network (of modal and chronological relations) in which these objects must hang, relative to one another, in order to make any sense as *historical explanations*. It is this space of modal implication alone that, as Whewell would say, upgrades merely “Descriptive Geology” into properly “Ætiological Geology”. And so, tracing the contemporary misconceptions surrounding this ‘modal web’ is essential, because it is only by getting to grips with its true nature (as, on the one hand, *not* rooted in mindless nature as per uniformitarianism; nor, on the other, as therefore *dispensable* concerning the business of natural explanation as per catastrophism) that we came to be able to properly articulate nature’s history and, thus, our prospective extinction within it. Modal and theoretical inferential relations are not natural, nor are they superfluous concerning our explanations of nature, because they are, instead, the very *metaconceptual toolkit* by which we are able to legislate conceptual descriptions and by which, furthermore, we were first able to grasp the corrigibility and

contingence of ‘the conceptual’ as such.¹ Their artifice is necessary yet not natural. And, thus, combining attendant theory-level or metaconceptual awareness of contingence (fully explored in the next chapter) with the empirical-level contingencies emerging from ‘geohistory’ we were first able to prognose our future extinction as natural historical event. In this chapter, we first establish the parameters of the problem of the ‘theoretical’ in geoscience, before exploring how both predominant schools failed to accommodate it such that they couldn’t underwrite coherent forecasts of X-risks.

1—PLUTONIC COOKERY

William Whewell, the first historically-minded philosopher of science (indeed, inventor of the term “scientist” [Ross, 1962]), wrote in 1840 that “[t]he scene of nature is a picture without depth of substance, no less than the scene of art; and in the one case as in the other, it is the mind which, by an act of its own, discovered that colour and shape denote distance and solidity”. Observation, in other words, is *theory-laden*: “[m]ost men are unconscious of this perceptual habit of reading the language of the external world, and translating as they read”. We have already delineated Cuvier’s use of this metaphor: paralleling the grammar-laden aspect of textual comprehension with the theory-laden saturation of empirical inquiry. Whewell’s meaning is identical, where he declares “there is a mask of theory over the whole face of nature, if it be *theory* to infer more than we *see*” [1840; i.23-4]. Therefore,

¹ We derive ‘metaconceptual’ from Sellars [1967 & 1970] who, by way of Carnap [1937], proposed a class of ‘metalinguistic’ locutions as a fitting ‘successor concept’ to Kant’s “categories”; or, vocabularies, such as categorial and modal terminologies, that, rather than directly describing objects, instead describe the conceptual framework within which objective description (necessarily) unfolds [Brandom, 2014].

the “mask of theory” refers to the globality of what Whewell calls “unconscious inference” in conscious perception. Observation is theory-saturated.²

Despite heavily foreshadowing many directions in contemporary philosophy of science and philosophy of mind, the polymathic work of Whewell remains underappreciated [Wettersten & Agassi, 1991; 345]. Whewell’s is a prescient corrective to bald empiricism, however: its Kantian provenances clear [Ducheyne, 2011; 17-23].³ Following this basis, he presaged modern developments by introducing “coherence” as criterion of truthfulness, whilst also inspiring Peirce’s later invention of “abduction” through his own coinage of “colligation”. This referred to the ‘creative act of hypothesis formation’ involving the bundling of empiric facts under a novel and superadded ‘*model*’ itself not present in observed facts [Baker, 2009; 260].⁴ Such abductive procedure is integral to geology inasmuch as geology is a *historical* science (as Peirce later stressed). Thus, as inventor of the very terms “uniformitarianism” and “catastrophism”, Whewell was, naturally, a key interlocutor in contemporary geotheoretical debates. For just as “unconscious inference” adumbrates insensate “distance and solidity” in quotidian

² This far-reaching idea remains as current as ever, particularly within contemporary neuroscientific theories of perception [Metzinger, 2004; 62-104]. Churchland [1979] reformulated the issue under the guise of ‘plasticity’. It must be stressed that endorsing theory-ladenness utterly does *not* commit one to relativism or anti-realism. Whewell, himself, was the prime scientific realist.

³ Claiming theory and perception inseparable, Whewell inherits Kant’s ‘togetherness principle’. He spoke of observations being inextricably mediated by “fundamental ideas” such as “space”, “time”, and “causality”. This clearly resembles Kant’s “categories”. Whewell stressed these “fundamental ideas” are open to revision: describing an intimate feedback-loop between theory-level elaborations and empirical-level observation, wherein framework emendation facilitates better observations and better observations enforce framework updates.

⁴ This forming his project to resuscitate “Baconian induction”, as inductions involving theory-generation, against restrictively enumerative conceptions of induction post-Hume. Whewell: “particular facts are not merely brought together, but there is a new element added to the combination by the very act of thought” [1847; ii.48].

objects, so too does a hard-won architecture of theoretical inference scaffold the otherwise unavailable depths of terrestrial time. Accordingly, Whewell bifurcated earth sciences into nakedly “Phenomenal” or “Descriptive Geology” and properly “Theoretical” and “Ætiological Geology” [1840; ii.101].

Around a decade earlier, Carlyle, in his *Sartor Resartus*, sardonically spoke of historical advances in science from Newton to Lagrange, from gravitation to orbital mechanics, finally exclaiming that, due to the “labours [of] Werners and Huttons”, we now similarly “know enough” of “Geology and “Geognosy”, such that

to many a [naturalist], the Creation of a World is little more mysterious than
the cooking of a Dumpling.

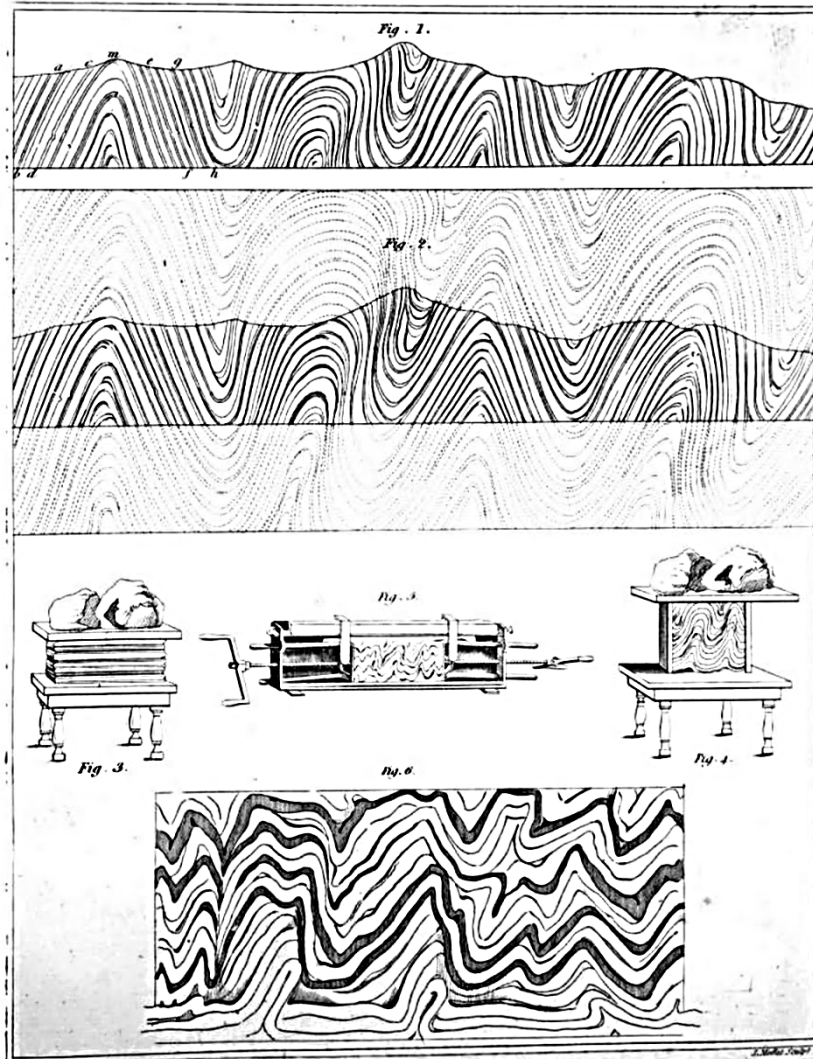
[2008; 3]

As satire of the thermal forces within the “great laboratory of the mineral regions” [Playfair, 2011; 69], such imagery had become somewhat conventional (with Whewell himself having referred to “Plutonic cookery” [1832; 125]). Similarly conventional is the mock-epic deflation: employing satiric technique typical ever since the Scriblerians first sharpened their quills against Royal Society projectors, Carlyle renders bathetic juxtaposition between planet and dumpling. Thus, mired as kitchen cosmogony or Lilliputian tectonophysics, Carlyle reduces geophysical theorization to culinary farce. Evidently his point is that world-formation cannot be reproduced *in vitro*: one cannot bake a planet in the laboratory, and his preposterous scenario of scientists manufacturing lithospheres from dough highlights this. Beyond irreverent lampoon this latches onto serious methodological debates, such as Lyell’s claim that “if man could witness the birth [of] worlds, he might reason by induction upon the origin of his own”: but, in prevailing “absence [of] data”, this is disbarred [2009; i.16]. Thomas Chalmers, echoing this, wrote regarding geoscience that “[w]e have no experience in the formation of worlds” and thus, in his opinion, must fall back on “revelation” [1848; 365].

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Cooking miniatures, however, was serious business [Bokulich & Oreskes, 2017]. Summer, 1767: Buffon, hidden away in his cellar-laboratory, heated up a series of iron balls—ranging in diameter from 0.5 to 5 inches—and measured their cool-down times, to ascertain, by analogy, the age of our planet based upon his refrigeration theory [Roger, 1981; 393-5 & Newcomb, 2009; 139]. Experiments like this date back to William Gilbert’s [1600] work on “terrellas” (spherical lodestones used to simulate geomagnetism at laboratory-scale). By the eighteenth century’s opening years, French chemist Nicolas Lémery [1700] had endeavoured to reproduce miniature volcanic eruptions [Amador, 2004]. Later, as geoscience matured, Saussure and others eventually developed blowpipes and pressure cookers to bake rock samples and experimentally resolve theories about petrogenesis [Newcomb, 2017]. Whilst modest mineralogical experimentations became widely accepted method, usage of scale-analogues for largescale geodynamics remained obscure [Ranalli, 2001; 67]. Until 1815, that is, when Scottish geochemist James Hall (who, aside from Playfair, was prime proponent of Huttonianism) deployed rudimentary scaling techniques to render miniature models of crustal folding and deformation. Using overlaid layers of cloth (and later clay), Hall attempted to recreate the rheological properties of ductile rock and lateral compression of strata [Ranalli, 2001]. Koyi records this as the ‘first documented analogue modelling experiment’ in tectonophysics [1997; 223]. It incepted a fruitful nineteenth century tradition of table-top scale-modelling (or ‘mimetic experiments’ [Galison, 1989]) via manufacture of miniature analogues of target-systems in structural geology, such as orogeny or glacial flows [Brandstetter, 2011b]. Eventually bolstered by early twentieth century explication of mathematically rigorous ‘scaling laws’ for dynamical similarity [Bokulich & Oreskes, 2017; 893-4], such practices flourished until their post-1960s eclipse by computer modelling [Oreskes, 2007]. Whewell, charmingly

PLATE IV.



Hall's stratal models [1815]

referring to Hall's miniature models, described Sir James as baking and kneading his geophysical "cake": drawing from the experimental "oven a marble loaf made of chalk flour" [1832; 125]. Even Buffon allegedly stated that geochemistry is nothing but "cooking", and that it placed "toils of the laboratory on a footing with those of the kitchen" [Jefferson, 2011; 431].

Despite alluring resemblance, Carlyle (geologically illiterate as he was) likely didn't know of Buffon's cooked globes or Hall's mimetic miniature mountain-ranges. (If he did, he would surely have balked.) Unaware of these burgeoning practices, his point is thus a broader one. The image of cultivating lab-grown worlds is satirical cipher and stand-in for Carlyle's common-sensical suspicion

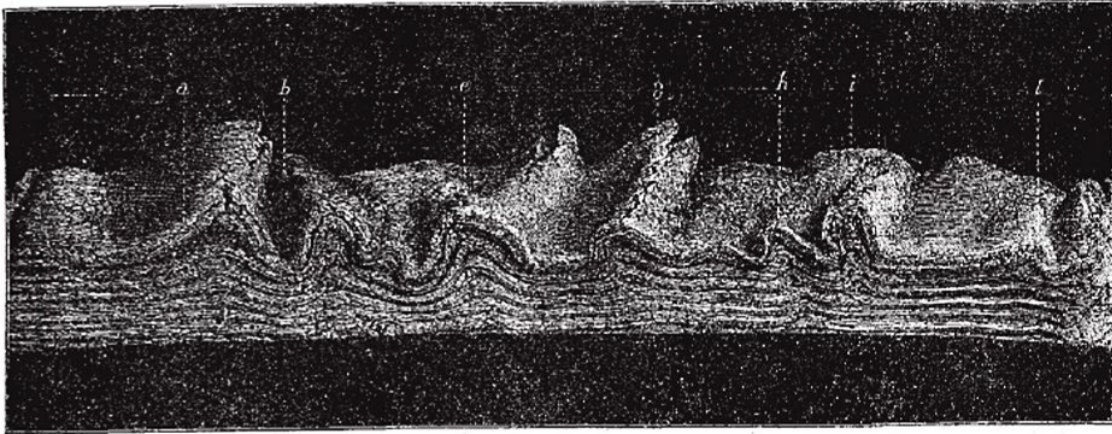


FIG. 1.

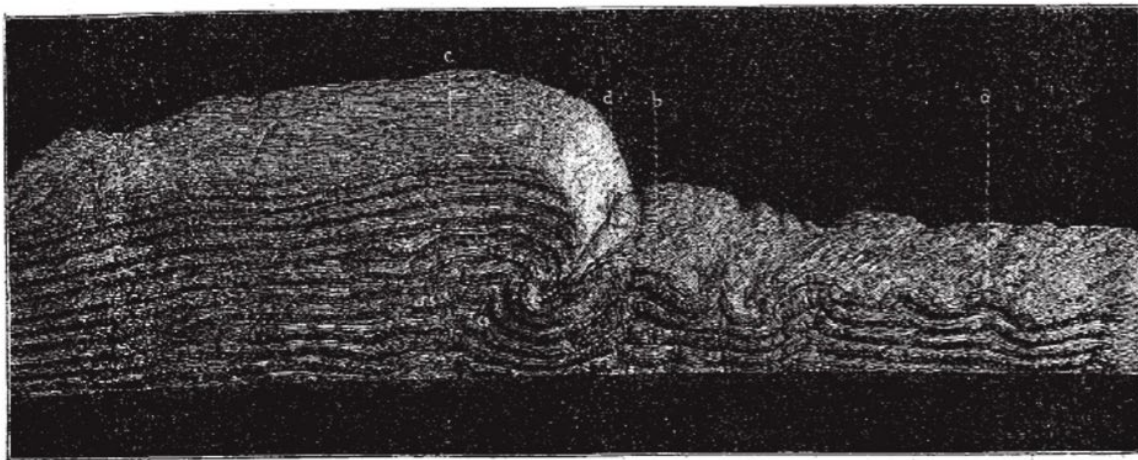


FIG. 3.

early orogenic modellings [Favre, 1878; 104]

that, in absence of inductive experience, the naked human imagination surely cannot become test-chamber for planetary-scale manipulations (as geoscience, due to the spatiotemporal vastness of its target-domain, requires it to). The human mind, Carlyle charges, cannot be *test-tube for worlds*. He aims his sights, therefore, at geoscience's proliferating web of theoretical entities: its presuppositional network of unobservable posits. He is aiming, not at physical miniatures, but *mental models*.

Later, corresponding with Ruskin, Carlyle betrayed his long-time disparagement for theoretical inference: “[n]ext to nothing rational could I ever learn of [geological] subject[s]”, he professed, what with their unobservable “central fire, and molten sea [whereupon] all mountains, continents, and strata

are spread floating like so many hides of leather” [1982b; 107-9]. Talking of such items, Playfair previously conceded that they “no doubt [are] a matter of THEORY”: being nodes within “invisible chains [of inference]” [2011; 90]. He readily admitted that the “greatness” of such “objects [...] alarms the imagination” [2011; 136]. Gigantism in space was only the ‘thin end of the wedge’, however: Whewell soon coined the term “palætiological” to denote such events as unfold, entirely unwitnessed, within deep time’s vastness. These processes were reportable exclusively via sophisticated inference. In his letter, Carlyle (typically kicking the stone of common-sense) duly quipped that the “real miracle of the phenomenon” is not geoscience’s purported spatiotemporal magnitudes but the “*length of ear* on the part of those” who entertain such theorisations.

The wider problem is that geoscience’s object-domain evaded not just laboratory reproducibility (like astronomy) but, in addition, also numerical reproducibility (unlike astronomy). Geology, that is, was late subsumed under *simulative rigor*. We pause to flesh this out. Simply put, ‘simulation’ pre-dates computers by multiple centuries; it is not constrained to silicon, it was merely automated by it. Electronic modelling *in silico* takes hold attendant upon the computational explosion after World War II [Elichirigoity, 1999], yet the practice of numerically modelling physical processes dates at least back to Leibniz and Newton’s seventeenth century invention of calculus [Grier, 2011; 57]. Calculus’s development empowered us to compute varying rates of change, thereby making nonlinear functions—from population growth to cometary paths—numerically tractable and, thereby, predictable [Krämer, 2011]. Alongside probabilism this was essential to the consolidation of long-term forecast. As Gramelsberger explains, ‘this resolution of processes into numbers [allowed] transformation of static mathematical concepts into computational time-stepping procedures’ [2011a; 19]. (As Grier [2013]

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recounts, these computations were originally delegated to teams of “*human computers*”, who, wielding logarithms following Napier’s 1614 introduction of them, crunched large datasets: from Leibniz to Babbage, savants dreamt of automating these time-consuming labours with various computational “engines”.) It was exactly this ‘quantification’ that allowed Montesquieu to transform simple population trends into an ‘intuition pump’ outputting (albeit using incorrect input-data and premises) his forecast of extinction-by-depopulation. Nonetheless, astronomy and demography submitted themselves immediately to such computisation (successful prediction of the 1757 return of Halley’s comet yielding early vindication), yet fields like geology and meteorology remained numerically intractable and non-quantified much later than their peers: for, though the fluid dynamics used today in tectonic-modelling can be traced back to differential equations developed in the 1770s by Euler, their relevance to geophysics only became applicable much later (after dimensional analysis accounted for how, at scale, rigid crust acts like ductile ‘pancake butter’ [Oreske, 2007; 112]).

So, in absence of simulation and in lieu of laboratory reproducibility, “palætiological science” instead had to rely uniquely upon what is now called *model-based reasoning* for manipulation of its target domain. This is *precisely* what Carlyle’s image attacks: the seeming unscrupulousness of inferring about planetary systems via ‘mental dumplings’, unattached from all observation reports. Nonetheless, unbeknownst to Carlyle’s age (due to undeveloped understanding of scientific methodology along restrictively ‘inductive-deductive’ lines) reasoning using mental models is not only *indispensable* regarding scientific procedure (especially theory change) but also to everyday cognition (being integral

to abduction, retroduction, diagnosis and hypothesis-generation).⁵ Model-based reasoning, in short, refers to inferences proceeding from the manufacture and manipulation of mental models, as analogues relative to a particular objective target-system. Such models may be static or dynamic (that is, involving ‘time-evolution’ or ‘timesteps’): in this latter case, one extrapolates according to salient constraints (‘rules-of-evolution’) transposed from the target domain. (These constraints aggregate to implement ‘plausibilistic’ boundary conditions. Selection of relevant limits is often tacit: i.e. based upon prior experience and domain-specific know-how.) Such reasoning, it is clear, expedites conceptual change in science [Nersessian, 1999]. (A plausibilistic thought experiment can defease incoherent theories by revealing incompatible constraints, for example.) As Nersessian [1999; 6] points out, thought-experimenting is self-evidently the eminent form of model-based reasoning. (Suitably, the term “*Gedankenexperiment*” was first circulated by the *Naturphilosophen* electromagnetist H.C. Ørsted in 1811 [Fehige, 2014], whilst sustained philosophical reflection upon the procedure begins with Kant, who ‘was preoccupied with the idea of mental experimentation’ [Virvidakis, 2011; 129].) And, as many argue [Guala, 2001 & Zeimbekis, 2011], such cognitive episodes can comfortably be classed as *mental simulations*. Thus, in absence of *in vitro* (laboratory) and *in papyro* (mathematical) reproducibility, early geoscience necessarily relied on simulation ‘*in cerebro*’ to supplement its *in vivo* field observations. Ergo, Buffon’s proclamation: “the best crucible is the mind”.

⁵ Things have changed since Duhem [1913; 304-11] decreed ‘thought experimenting’ illegitimate and Carnap [1939; 67] deemed ‘models’ parasitic upon scientific inquiry. Presaged by Ernst Mach’s reevaluations [1896], Kuhn first classified thought experiment a ‘potent tool’ [1977; 241-61]. They have since been unveiled as indispensable [Arcangeli, 2017]. Alongside growing focus of thought experimentation, there is now a burgeoning literature on model-based reason in science, technology, and machine learning—spearheaded by work from Nersessian & Magnani.

–the best crucible is the mind–

In 1721, Matthew Prior wrote of “system-makers and world-wrights”; Hume, by 1779, wittily describes the contemporary “*art of world-making*”, implying that, out of the proliferating array of world-models, only one could be ‘correct’. All of the other ‘worlds’, therefore, must be deemed “botched and bungled” [Ramachandran, 2015; 1-22]. Certainly, the century saw a veritable ‘Cambrian Explosion’ of vastly diverging world-plans (of variant scrupulousness and empirical plausibility) from wild diluvial conjectures to hollow earths.⁶ Inchoate though it was, this was the first introduction of the globalized thinking—upon planetary systems, dynamics, and scales—required to later truly grasp extinction’s necessarily global prospect (we return to this in Chap.5). Nonetheless, reacting to these hypothetical predispositions, Playfair later diagnosed a “mental derangement”, endemic amongst his scientific peers, typified by compulsive mental construction of fully-formed “terraqueous and habitable globes” [1811; 207-8]. Contradicting Buffon and Hall (whilst presaging Carlyle), Hutton also complained of those who claim to know “those regions of the earth which can never be seen, from having kindled a fire and looked into the bottom of a crucible” [1795; i.251].

What was at issue? As explored, theoretical reasoning in geoscience is loaded with unobservables and modally-rich inferential moves. Simply put, the proliferation of these postulates progressively unmoored our understanding of the wider physical world from the qualitative ‘lifeworld’ of empirical contents—thus strongly insinuating the regionality and precariousness of this latter—which was

⁶ Granting extra meaning to Kuhn [1962; 150]: ‘the proponents of competing paradigms practice their trades in different worlds’.

instinctively apprehended by empiricist and ‘Common Sense’ thinkers, like Carlyle [Jessop, 1997; 137-8], as pernicious, axiologically threatening, and to be prevented.⁷

Cuvier’s palaeoecologic reconstructions, however, are exemplar cases of model-based reasoning: because of the nature of organism (its holistic and interwoven “*conditions d’existence*”), anatomies couldn’t be reassembled atomistically (or without prior image of the whole), but only via proceeding from some mental blueprint or abductive model of the living animal (only this explains Cuvier’s lauded ability to identify ‘biota’ from ‘bone’). In this, organism becomes codified as a complex series of conditionals and sufficiency relations (a predator must have “teeth” to “feed on flesh”; “digestive organs” purposed for this “kind of food”; “sense organs” calibrated for “perceiving [its] prey”; adjusted means of “locomotion”, etc.; and “if things were not so [then] the animal could not subsist”). Cuvier’s anatomical ingenuity was predicated upon abstracting jumbled bone into just such a modally-involved inferential web. When scaled to issues of geophysics, the very same applied. The geologist, that is, must *turn the world to theory*. A modally-rich “mask of theory” saturates any and all reasoning upon geological affairs within the so-called “Ætiological” register. Geology, indeed, was in the business of sounding out the laws of earth systems. And the concept of ‘law’ holds expressive weight only insofar as we consider laws as *subjunctively robust* (i.e. capable of supporting counterfactual cases: laws must be understood as holding across merely possible worlds; or, not only in those situations which *do* happen, but, additionally, those which *do not*).⁸ Science’s lawlike statements, therefore, proffer

⁷ Scottish ‘Common Sense’ philosophy argued, naïvely, for an essentially reactionary return to the authorities of intuition and doxa.

⁸ ‘Law-statements support counterfactuals. If the law-statements are true, then the counterfactuals supported are said to be true’ [Armstrong, 1983; 43]. Therefore, their ‘correct application has necessary

explanatory power only by putting merely actual states of affairs *in relief* against a reference class of non-actual and utterly theoretical states. As John Herschel (Whewell’s friend) contemporaneously realized, “every law is a provision for cases which *may* occur, and has relation to an infinite number of cases that never have occurred, and never will”: this “contemplation of possible occurrences” (i.e. *counterfactual robustness*) marks out the “notion of a *law*” against weaker and less involved assertions [1830; 36].⁹ (It is precisely such modal involvement that accounts for how lawlike statements can *predict*: setting them apart from mere labellings.) Only when refracted through this “mask of theory” can geology become legible as *geohistory* (and scientific description as *scientific explanation*). Nonetheless, insofar as, when scaled to the dimensions necessary for geology, this comprehensively decenters and dwarfs the human lifeworld of the tangibly empirical, it was met with deep suspicion from the defenders of qualitative meaningfulness and its indubitable foundations: ultimately provoking a kind of reactionary protectionism (exemplified by Carlyle’s biting satire) concerning what they perceived as the axiological dangers of global abstraction.

Later in *Sartor*, Carlyle protests that “let but a Creation of the World happen *twice*, and it ceases to be marvellous, to be noteworthy, or noticeable” [45]. Such iterability, of course, implies laboratory reproducibility but, in fact, ultimately alludes to geology’s reliance on counterfactuals (granting the Earth a proper history—and thus necessarily mapping its dynamic laws as counterfactually robust—requires cognitively contriving *other* Earths). This is exactly what perturbed Carlyle so much, even if he

conditions that would be expressed explicitly using subjunctive conditionals, and hence depends on what is true in other possible worlds besides the one in which it is being applied’ [Brandom, 2014; 67].

⁹ Likewise, for Novalis, “[w]e will be physicists only if we use *imaginary* products and forces as regulative measures for *natural* products and forces” [Fehige, 2014; 189].

could not explicitly say why: reverse engineering the lawful operations and dispositions of planetary dynamics involves revealing our own epochal state (thus, conterminously, also our species’ “*conditions d’existence*”) as modally parochial and consequently precarious (as only the latest coordination of wider parameters and variables outnumbering those currently in play—liable to revocation, transformation, and reorganization). Geoscience, in short, radically expanded the ‘parameter space’ of the earth system. Certainly, Carlyle’s use of indefinite articles to specify “the Creation of *a* World” and “*a* Dumpling” is integral here: to modify Cuvier’s words, geology burst not just the limits of time, but also of modality; rupturing plenitude’s ringfencing of the potential to the actual by unveiling the deep globe as a dynamo of possible worlds; ‘worlds’ potentially *entirely* detached from the human lifeworld and its special “*conditions d’existence*”.¹⁰ So, though he inherits mock-epic conventions that Swift used to respond to the spatial disorientations triggered by the microscopic and telescopic purviews of the earlier Scientific Revolution, Carlyle here updates Scriblerian convention and repurposes it to now capture the properly *modal disorientations* of subsequent Geohistorical Revolution (a revolution compelling Cuvier to index ours as the “*creation actuelle*”: a qualifier previously unnecessary). Shunting the horizons of terrestrial possibility far beyond the meagre horizon of empirical availability, geoscience incisively undermined residues of the common-sensical foundationalism assuming unproblematic adequation between the two (undermining them in a manner similar to the “dreadful Hammers” which Ruskin imagined chipping away at Genesis’s narratological monopoly: “I hear the clink of them at the end of every cadence of the Bible verses”, he mourned [Ruskin, 1903-12; xxxvi.115]).

¹⁰ Creating a modal decentering compounding Copernicus’s spatial one. Indeed, as Chap.2 established, it is *only* when modulated through the former that the latter announces truly radical challenges to our self-image and existential security.

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Carlyle, therefore, is reacting to the fact that in order to *naturalize* we must *artificialize*: or, in order to know reality ever better we must increasingly supplant and replace our seemingly ‘natural’ categories of perception (those lionized by ‘Common Sense’ philosophy) with progressively artificial and theoretical artefacts (models, hypotheticals, formal languages). Carlyle’s image operates as symbolic proxy for this discursive process of the de-semantification of ‘world’ itself: or, the eclipsing of the empirical lifeworld, and its inborn horizons, with the theoretical entities—of empirically unrepresentable age, size, and dynamism—contemporaneously being assembled by burgeoning earth systems science. Carlyle cannot but see this supplanting as axiologically deleterious: indeed, there is definite implication that it is to be diagnosed, furthermore, as *existentially damaging*. For, in his attempted *ad absurdum* of scientific modelling, Carlyle’s image implicitly asks, ‘where would the laboratory *be* that conducts experiments upon *being* itself?’, or, ‘how does one *experiment* on that which *includes* the experimenter?’. To do this, his image implies, automatically makes us ‘denizens of the dumpling’: as ontologically trivial, contingent, and disposable as the doughy snack we have revealed ourselves to live upon. This pinpoints Carlyle’s larger insinuation regarding science’s ‘view from nowhere’ and how it is somehow nihilating *apropos* whoever does the viewing. This is over-dramatic and inflated (physical destruction is distinct from rational defeasibility), yet there remains a scrap of truth to it. For the metaconceptual framework within which the update and procedural supplanting of perceptual theories takes place is necessarily also the cognitive toolkit by which we self-reflect upon the fallibility of our perceptual lifeworld *in toto*. Or, our ability to increasingly make the entire world ‘a dumpling’ (i.e. to model the physical world as completely otherwise than we experience it—doing so within the mind’s abductive ‘terrarium’) depends upon increasing acknowledgement that our own phenomenal world of

experience, in its entirety, is *always already* a ‘dumpling’ or ‘terrella’ (i.e. interminably a fallible model rather than anywhere a perspicacious and infallible microcosm). In artificializing the outer world (replacing it with theory), we congruently spell out for ourselves that our own phenomenal world has also forever been ‘artificial’ (in the sense of theory-laden). Consciousness realises itself as globally theory-bound—conterminously subtracting itself from firm foundations in non-conceptual existence—thus first facilitating coherent statements upon the termination of conceptual contents within said existence. Though Carlyle sees this as axiologically hazardous, it is nothing but mind taking responsibility for itself: for, mind is self-determining—thus self-correcting and self-updating—*only* to the degree that it realises that, insofar as it exists and persists, it does so exclusively and singly through this very culpability for itself and the correctness of its contents, such that, through disembarking from all external tribunals and becoming disillusioned with all circumspect foundations, mind resolutely acknowledges that existence never owed it anything and, as such, there was and is no guarantee that mindedness need exist nor indefinitely persist *unless it reasons ever better and becomes more correct in its picturing, and predicting, of reality*. Thus, science’s artificialisation is only ‘risky’ in the sense that acknowledging peril, *rather than ignoring it*, is ‘risky’. This is precisely identical with emerging from nonage. The artificialisation of our “pendant Earth”—its ongoing replacement with “THEORY” and those “invisible chains” of inference—is nothing but the mark of intellectual honesty.

As mentioned, however, both major geological schools reacted misguidedly to this *metaconceptual* functioning of the framework within which all theoretical entities must be implicated, adjudicated, and appraised. In short, where Lyell reified it, Cuvier abandoned it. And so, despite opening up nature’s supra-human chronology and contingency respectively, neither could coherently habituate robust

prognostications upon future X-risks. We explore the first portrayal of said ‘framework’ as properly metaconceptual in the next chapter; for now we triangulate the twin failings of uniformitarianism and catastrophism, and how, though in opposing and idiosyncratic ways, they both exemplify misgivings of Humean empiricisms and their inability to deal with such questions of existential import.

2—UNIFORMITARIAN REIFICATION

Uniformitarianism—announced by Hutton, proselytized by Playfair, systematized by Lyell—held that nature was uniform, or self-similar, over time. (Uniformity, as Peirce later clarified the term, denotes that ‘Every A is B ’ or ‘There does not exist any A which is not B ’ [1955; 224]. This can be compressed into a material conditional: ‘ $A \supset B$ ’. In plain language, nature’s regularity never admits of exceptions.) This blanket claim of uniformity, on closer inspection, disaggregates into committals to various subtype uniformities [Hooykas, 1963]: some are indispensable to naturalistic inquiry; others, however, are utterly overreaching. We now explore the distinction (unpeeling ‘utile’ from ‘stultifying’) thereby discovering how, despite initially setting out to promote naturalism in physical chronology, uniformitarianism ironically ended up becoming bizarrely idealist (and, ergo, incapable of accrediting the ‘realism’ of extinction).

The name, coined by Whewell (though he was himself Lyell’s ‘most important’ critic [Baker, 1998; 176]), refers to usage of “uniform” to connote constant causal conjunction as used in Hume’s *Treatise* and his explication, therein, of the fact that empiricist induction presupposes—and depends upon—a ‘principle of uniformity’ [2003; 64], or, presumption of exceptionless regularity across time.

Impressed by this, the uniformitarians made it the core of their philosophy [Baker, 1998]. They inherited two central lessons from Hume: 1) that modals cannot be substantiated within experience,

thus must be expunged from empirical inquiry, and 2) thus the only basis for induction (and thereby, as they saw it, all natural knowledge) is the constant conjunction or uniformity of items within direct experience, a constancy Hume had grounded by way of “custom”. In excising the former (i.e. modals: being the language that we use to articulate the intensions of laws, both ontic and deontic), Hume forewent any chance of explicating that his ‘uniformity principle’ is, in fact, an *explanatory rule* and, thereby, not a *foundational given* (as “habit” attempts to establish it as). In other words, ‘uniformity’ is, ultimately, a regulative norm invoked to enforce the updating of our explanations when we encounter contravening data: it is used to regulate observation reports, rather than being itself anything we directly observe; thus, it is presupposed, but as a motivating *goal* to be achieved, rather than a foundational *datum* passively received.¹¹ This is what caused uniformitarianism’s characteristic problems. For, in following the first lesson, they excised all modal expressions and unobserved events from geoscience, thus effectively expunging history from geohistory insofar as historicity requires the non-actual and unobserved; and, in applying the latter lesson, they are led to effectively reify the explanatory norm of ‘uniformity’ as limitation of independent nature; thus, where ‘uniformity’ is now an unbreakable metaphysical principle rather than a impelling methodological maxim, this combines with former excision of theoretical entities to basically subtract time and mind-independence from nature. The uniformitarian, in other words, threw the geohistorical baby out with the subjunctive bathwater. Restricting the unobservable to the observed—and thus also the possible to the actual—they effectively expelled ‘history’ from this most historical of sciences.

¹¹ Cf. Sellars [1957; 302-7].

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Indeed, we have already seen how uniformitarianism couldn't countenance true extinction because of its conviction of homeostasis. Lyell, confidently championing "invariable constancy in the order of nature" [2009; i.86], led himself, through diehard adherence to his principles, to opine that *dinosaurs will one day reappear*. Having reified methodological rule as metaphysical maxim, he 'extended uniformity of state to life' [Gould, 1987; 123], thereby infamously assenting that "[t]he huge iguanodon might reappear in the woods". (He spoke to Mantell of de-extinct iguanodons repopulating a future Sussex [Rudwick, 1975; 558].) By corollary, there is also no extinction for us. Certainly, despite admitting he was "indulg[ing] in speculations" [2009; i.123], this (rightly) did not protect Lyell from caricature for this utterly bizarre thesis. The well-known illustration by Lyell's peer Henry de la Beche imagines the 'tables turned' [Rudwick, 1975; 537], with bespectacled *Ichthyosauri* lecturing, in some



A Lecture, — "You will at once perceive," continued Professor Ichthyosaurus, "that the skull before us belonged to some of the lower order of animals, the teeth are very insignificant, the power of the jaws trifling, and altogether it seems wonderful how the creature could have procured food."

[Rudwick, 1975; 539]

distant future, presumably upon the inevitable return of extinct *Homo sapiens*. Hence, Lyellianism's reduction of terminalist extinction to "merely local" latency and an "interval of quiescence".

Nonetheless, despite such extravagances, uniformitarianism (especially in Playfair and Lyell's hands) conceived of itself, in line with its Humean roots, as motivated entirely by sober and naturalistic empiricism. It self-promoted itself as driven by a "desire to pursue the science according to the rules of inductive philosophy" [Lyell, 2009; i.257]. Why, then, the de-extincting dinosaurs?

In adhering closely to "inductive philosophy", uniformitarianism shared with positivisms past and present the desire to reduce all non-logical vocabulary to vocabulary that is baldly descriptive of empirical content, or, if such reduction is unworkable, to otherwise deem these vocabularies illegitimate and eliminable. Modal vocabulary (hypotheticals, subjunctives, etc.) is notoriously hard to reduce to narrowly empirical-descriptive roles (as Hume first noticed). Given this, the unobservables and mental models of geohistory (manufactured, as they are, from modally-rich inferences) were therefore considered with suspicion by "inductive philosophy". Following this, such items were duly exiled from 'legitimate' science, as conceived from Hutton to Lyell. The exorcism of these forms of reasoning led the uniformitarian to eliminate what they called "unknown and extraordinary powers" [Playfair, 2011; 117] from geohistory (thus successfully banishing providential or supernatural causation from the picture), yet, insofar as such inferences and models are required, however, to postulate "palætiological" events and operations *meaningfully distinct* from those currently actual, they also eliminated history from geoscience and reduced the unobservable to the observed. Possibility was exhaustively reduced to current actuality: all 'change' thereby becoming either compensatory, circulatory, and time-

symmetric.¹² Shearing hypotheticals and conditionals from the body of geological reasoning, they also amputated any capacity for *real change* in natural history. Hence, the Huttonian-Lyellian vision of ‘steady-state’ earth systems—wherein nothing is lost and nothing ever gained—licenses a return of plenitude with a vengeance.

This is how modest inductive empiricism, when overzealous in its positivistic ambitions, is inexorably led into erroneous metaphysical extravagance (i.e. necrofaunal resurrections). Because, simply, in assuming that all language must directly describe (e.g. *all* geological assertions must be straightforwardly declarative, or, denote currently actual items) one loses the language that tracks the limits of description as such (i.e. one loses grip upon one’s limited perspective upon—and within—terrestrial history). In so doing, one relinquishes capacity to distinguish those heuristic values which are presupposed by objective experience and the direct objects of experience itself, such that one is blindly and inevitably led to presume that aspects and artefacts of our cognitive framework simply *are* principles of independent nature. It should come as no surprise, therefore, that the end-result of uniformitarianism was total inability to commit to the naturalistic senescence of cognizing animals, insofar as it hypostatizes cognitive constraints as constraints of widest nature.

Certainly, we should not undersell Hutton’s and Lyell’s contributions to the maturation of geoscience (for example, their predilection for a ‘parsimony of causes’ played out, in practice, as ‘gluttony for time’—insofar as a modest suite of modest forces demands gigantic durations to create

¹² Uniformitarianism’s *ultimately aesthetic* premium for ‘time-symmetry’ derives from Lyell modelling his *Principles* upon Newton’s *Principia*. Indeed, the entire project was implicitly coded as the midwifing of geology from ‘low’ to ‘high’ science. Hossenfelder [2018] recently showed such detrimental influences still operative in modern physics.

gigantic effects—thus first comprehensively pushing chronology beyond the Bible’s flyleaves), yet this should by no means occlude appreciation that uniformitarianism’s *holus-bolus* rejection of theory-talk actively stultified the development of the science for decades to come.¹³

Keeping ‘utile’ and ‘stultifying’ legacies of Lyellian thought distinct—thus properly evaluating its position in our history of X-risk awareness—requires disaggregation of the subtype uniformities bundled within its overarching committal to nature’s ‘lack of exception’. After Rudwick [1972] botanized this overarching claim into separate uniformities (of ‘law’, ‘process’, ‘rate’, and ‘state’),

¹³ As established, Playfair pathologized theoretical inference as poetic frenzy: a “mental derangement”, whereby ‘literary fancy’ infects ‘positive science’. (He convulsively classified Buffon’s thermic terminus as equivalent to the “wild fictions [of] Scandinavian mythology” [2011; 474].) This was, in some ways, understandable. It was counter-reaction to the extravagances of the previous century’s “worldwrights”. Yet such accusation does not appreciate that such “botched and bungled” models are necessary to facilitate conceptual change in science (as, by analogy, natural selection requires colossal deselection). Indeed, from Kuhn [1977; 263] to Nersessian [1999; 8], scholars now identify proliferation of models as indicative of periods of conceptual reform in science. Certainly, the dismissal of theorization as poeticism was rooted less in any real superfluity of model-based reasoning and more in contemporary lack of discursive metavocabularies within which to make explicit what one is *doing* when one is *saying* things in *irrealis* moods (a job now fulfilled by various modal logics). A candidate metavocabulary had been supplied in Leibniz’s ‘possible worlds’, which had been extended beyond theodicy by Baumgarten [1735; §52-3], though it was here used solely to specify literature as “HETEROCOSMICA”. Philosopher-scientist G.C. Lichtenberg (along with Kant, Novalis, and Ørsted) later attempted to defend thought experiments; however, the status of inferential models here remained, at best, products of ‘poetic imagination’ [Fehige, 2014]. Accordingly, Goethe wrote, concerning geothory, that “in speaking of primal beginnings we should speak primally, i.e. poetically”, because, of the descriptive roles “to which our everyday language pertains [...] none is adequate to the task”. (Thereby professing that “[u]pon entering deep [into] rocky chasms, I felt for the first time that I envied the poets” [1988; 137].) Goethe here identifies the problem, correctly, as an *expressive* problem, yet mistakenly identifies *poesis* as best candidate vocabulary for its expressive solution! Comments such as these would not help theory’s status. Despite this, the theory-poetry comparison persisted into ‘principled’ geology: Mantell promoted past worlds as “more marvelous [than] even romance or poetry” [1838; 38]; and even Charles Darwin later deemed geological hypothesizing “truly poetical” [1987; 529]. Comparison to *poesis* acted as *semantic crutch* (placeholder in lieu of technical metavocabularies to account for what one is doing whilst performing abductive theorization), yet, uniformitarianism, in prematurely severing this crutch, amputated the limb.

Gould [1987; 118-24] thereafter provided a higher-order separation into *methodological* and *substantive* commitments ('law'+ 'process' being methodological; 'rate'+ 'state' being substantive). It is clear that methodological uniformity is indispensable to inquiry and still upheld, rigorously, by all present-day geologists (though it is now nomenclated 'actualism', for clarity's sake [Kravitz, 2013; 22]), yet Lyell's substantive uniformities are unwarranted and utterly evidentially discredited (given evidence, snowballing since the 1950s, for the 'big five' phanerozoic Mass Extinction events [Hallam, 2004]). What is important for our purposes, is that, in abandoning precisely the language by which to distinguish between methodological rules and substantive realities (or explanatory values and descriptive features), Lyellian empiricism was led to reify heuristic artefacts and constraints (namely, science's regulative ideal of logical parsimony alongside aesthetic ideals of symmetry and simplicity) as features of mind-independent nature.¹⁴ As such, no catastrophe or terminus. Catastrophes (such as mass extinctions) are inherently unparsimonious (indexed by exceptionality rather than exemplarity), and thus, insofar as uniformitarianism had hypostatized the logical *value* of parsimony, it simply could not accredit the fossil record's evidences of sudden and gigantic extermination.

Emendation of this 'dogma' took generations [Baker, 1998; 173]. Gould [1987] referred to a once hegemonic tradition of 'hagiographic' accounts of uniformitarianism in science histories (the first of which was undoubtedly Lyell's own retrospect, opening his *Principles*): for, confluent with Darwinism's post-1860 successes, gradualism vanquished Cuvierian catastrophism and stigmatized 'catastrophic'

¹⁴ 'Whereas abductions based on beauty converge with parsimony, abductions based on the sublime diverge from parsimony. Awe stifles our inner accountant. Both types of abduction are popular. Both are dubious because we lack independent assurance that the universe is beautiful or sublime' [Sorensen, 2014].

explanations in geoscience [Raup, 1999].¹⁵ This remained firmly the case up until the 1980s, when the father-son Alvarez [1980] team found convincing evidence of a violent dinosaur-killing bolide impactor event: consequently upturning centuries of uniformitarian orthodoxy.¹⁶ Since then, mass extinction has been revealed as a major factor influencing macroevolution [Erwin, 2006]; moreover, a ‘neocatastrophist tendency has recently become almost default in a wide range of fields’ [Ćirković, 2018; 170-1]. (The ‘neo-’ denoting supersedure of the not-at-all insignificant errors of Cuvierian catastrophism—studied in the next section.) Indeed, proving that this debate is not of mere antiquarian interest but persistently informs contemporary issues of literally astronomical importance—issues, moreover, that are directly relevant to X-risk and macrostrategy—we note that ‘neocatastrophism’ has arisen as a proposed solution to the Fermi Paradox (hypothesizing a backdrop of life-exterminating galactic events, e.g. gamma-ray bursts, as explanation for conspicuous absence of signs of extraterrestrial intelligence; recalling that this absence provides us with probabilistic evidence *apropos* our own long-term fate [Ćirković, 2009b]). Indeed, ultimately, the very distinction between categories of ‘catastrophe’ and ‘uniformity’ boils down to questions of perspective regarding our position as *concept-using observers* within epochal cosmological history (known as ‘anthropic bias’ [Bostrom, 2002]) and, thereby, it rests upon our capability to track the distinction between *conceptual witness* and *cosmic backdrop*, such as to self-reflect upon the positionality of ‘conceptual witness’ as such (and so improve our grasp of nature’s dynamical shape, or, lack thereof; whilst, in the process, inevitably

¹⁵ Notwithstanding, John Phillips, as early as [1860; 66], noted the pattern of vast biodiversity losses between “CÆNOZOIC”, “MESOZOIC”, and “PALÆOZOIC” biota.

¹⁶ The hypothesis based itself on the discoveries of iridium at the Cretaceous-Paleogene boundary (evidencing an extraterrestrial source) and a crater, of similar age, beneath the Yucatán Peninsula [Alvarez, 1999].

learning about the precariousities of anthropic observation *in toto*).¹⁷ In Ćirković’s words [2018; 53], ‘we should regard what we observe as typical *only after taking into account all preconditions for our emergence as intelligent observers at this cosmic epoch*’: meaning that, as it scales to astrophysical horizons, ‘objective’ knowledge of the cosmos increasingly becomes entangled with triangulation of our positionality as ‘subjects’ within it, and, thus inevitably, also the precariousities thereof.¹⁸

Without theoretical locutions we cannot gain traction upon our positionality as observers in space and time. In foregoing this capability (due to overambitious positivism) the uniformitarians forewent any workable or meaningful distinction between the observed and the unobservable (shored up, as it is, by theoretical postulates). In so doing, they ultimately ended up levying the limits of sensation upon insensate nature, amputating history from natural history, and reifying constraints of intuition as if they were nomological limits upon the earth system. In this precise sense, uniformitarian science ended up just as ‘idealist’ as the physico-theological outlook it sought to eradicate: wherein nature, across both, becomes the interminable embodiment of judiciality. Though reached through a sceptical empiricist (rather than ontotheological) route, the destination is the same. Both discriminate what is ‘in’ the territory (mind-independent nature) solely via the map (human sensoria and intuition). This constitutes precisely what Kant titled a “*transzendente Illusion*” (‘transcendental illusion’) [CPR; A296-7/B353-4]. Presuming all language describes empirical content, they lose the language that

¹⁷ For example, intelligent observation’s necessary position within a proposed ‘galactic habitable zone’ [Gonzalez et al., 2001] might bias its view of its surrounding astrophysical landscape. At smaller scales, the exact same principle is at play in palaeontology’s ‘Signor-Lipps effect’ [Signor & Lipps, 1982], which attempts to mitigate for distortions inherent in our incomplete purview of the fossil record.

¹⁸ We read this as vindication of Kant’s basic ‘Copernican’ insight that one knows reality better by triangulating our insuperable positionality within it.

distinguishes between regulative values presupposed by empirical experience and the objects of experience itself. Thereby, once again, in ontologizing cognitive categories, one's ontology cannot effectively encompass the terminus of cognitive content. Hutton and Lyell's cyclical eternalism and claustrophobic plenitude, by exact corollary, denied any 'conception of a prehuman and therefore radically nonhuman world' [Rudwick, 2007; 118].¹⁹ Conversely, there is also no posthuman one. It is, indeed, obligatory to cite Hutton's mantra: "no vestige of a beginning,—no prospect of an end". We thusly note the irony that Hutton—who comprehensively eliminated temporality from his system—is venerated as founder of *deep time*. Infinite depth, however, is no depth at all; eternally falling, indeed, is just an orbit.

3—CATASTROPHIST SUBTRACTION

Where, through the seventeenth and eighteenth centuries, nature's lack of propositional structure had become increasingly apparent, empiricism moved in to reground knowledge in sensation as opposed to demonstration. However, in the hands of practitioners like Lyell, empiricism's new grounding (precisely by abjuring locutions upon unobservables) led straight toward reifying experiential categories once again (namely, regulative presuppositions and ideals such as logical parsimony). This stymied any coherent grasp of the lessons of natural history *apropos* future X-risk. The competing brand of empiricism, however, intuited that regulative constraints such as 'uniformity' do not straightforwardly 'exist' in nature. It responded, however, by ejecting them from inquiry

¹⁹ Holbach, indeed, noted that the prejudice that "*whatever is, is right*" leads people to presume *Homo sapiens* immutable because they "conjecture that other planets, like our own, are inhabited by beings resembling ourselves" [1795-6; i.147]. Hutton and Lyell's cyclical eternalism merely transposes this chronologically.

entirely; thus, it produced an equally distorted picture of terrestrial history; this competitor was, of course, Cuvierian catastrophism.

Instead of jettisoning unobservables, catastrophism helped itself readily to them, yet only inasmuch as they are shorn entirely of explanatory role. For, intuiting that the framework of modal relations within which these objects hang as precisely that—a heuristic framework open to fallibility—Cuvier simply did without it. As such, both empiricisms were Humean, yet in diametrically opposed directions (which is illuminating as a case study concerning the relation between sceptical empiricism and X-risk awareness—cf. Section 5.4, Chap.4). For, where uniformitarianism, unable to account for modal commitments, relied on *faith* in ceaseless conjunctions (yet an ontologized faith in nature's *a priori* logical simplicity), the catastrophist, reducing all etiological explanation to atomized descriptive labellings, thus instead called the bluff on Hume's sceptical problem of induction by acceding *genuine changeability in the laws of nature*. That is, the inability to demonstrate nomic necessity is, in Cuvier's hands, no longer an epistemological dilemma but an ontic factum: for, like Hume, Cuvier held that the reliability of laws could not be demonstrably established; unlike Hume, he further believed not only that laws changed but that *they already had*.²⁰ This is how he explained the picture of epochal saltation and vastly divergent world-orders being contemporaneously implied by the stratigraphic fossil record. Whilst thus undoubtedly encouraging propositions upon human extinction by utterly disarticulating orders of rational justification and of mindless existence (indeed, the conversations of the Shelley-Byron circle regarding humanity's long-term prospects revolve around Cuvier), Cuvierian catastrophism

²⁰ Thus, laws aren't merely contingent yet somehow changeless—as in what philosophers call a 'Hume world' [Jackson, 1977]—but *have frequently already changed*.

nonetheless goes much too far in jettisoning the explanatory role of rational justification outright, thereby ultimately proffering an unworkable scientific prospectus (one that could *describe* but not allow us to *explain*—thus reliably forecast—extinction events and natural termini). The baby was again thrown out with the bathwater: in exploring how this happened we elucidate what it means that our justificatory framework (or the ‘space of reasons’ within which all declarative and objective assertions necessarily hang relative to each other) is *necessary but not natural*.

A false dichotomy was tacitly (and tactically) enforced by Lyell’s ‘self-serving rewrite’ of geoscience’s history [Gould, 1987; 66]. Continuing his merger of substantive uniformity with methodological naturalism, Lyell implied a binary decision between ‘parsimonious naturalism’ and ‘non-parsimonious supernaturalism’. Yet Cuvier’s catastrophism, despite readily rejecting parsimony in its explanations, was not physico-theological or supernaturalist in *any* degree (as Rudwick amply establishes).²¹ This, however, was muddied by Cuvier’s Anglophone reception (starting with Robert Jameson’s distorting [1813] translation, continuing into the theistic catastrophisms of British geologists like William Buckland) thereby unfortunately only ratifying Lyell’s carefully poised ‘false dilemma’ within subsequent histories of science. Notwithstanding this, what makes Cuvierianism philosophically interesting is that it offers a fully naturalistic account of non-uniformity, or, lawbreaking. That is, Cuvier’s meaning of ‘catastrophe’, as an entirely singular advent, was not an appeal to supernatural justification for phenomena seemingly not naturally justifiable, as it was, in fact, a straightforward

²¹ Many Parisian peers regarded Cuvier a sceptic, even an atheist, whilst his loyalties to the Protestant church appear merely formal. Rudwick arbitrates that nothing suggests ‘a man of evangelical zeal’ [2008; 259]. Moreover, in Cuvier’s geotheory, God is conspicuously absent. Compare this with Buckland’s incessant imputations of the “direct agency of Creative Interference” [1836; 436].

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assertion of a total lack of justification within natural reality: i.e. nature itself has ‘no nature’ (in the sense of nomic essence) and it breaks its ‘laws’ on its own. Cuvierianism, that is, does not outsource lawbreaking to divinity but keeps it entirely immanent. This, therefore, is the precise inverse of plenitudinarianism’s identification of jurisprudence and existence. No longer autarchic essence nor prudential identity, nature, within catastrophism, is nothing but *sovereign time*: wherein even laws themselves have durations of appearance and divestment.²²

Geotheorists, since at least Buffon [Baere, 2008], had grappled with the position of ‘catastrophe’ in scientific accounts of earth history, because, insofar as ‘catastrophe’ is defined by its unpredictability (*qua* singular or unprecedented event), it generates tension with the scientific desire to subsume events under parsimonious law-statements (‘Every *A* is *B*’, or, ‘ $A \supset B$ ’). Yet, in earth sciences more than other sciences (because of their position as *historical* sciences), cataclysmic singularities have long ‘dulled’ Ockham’s razor, so to speak. From Hume [1992; 46] to Holbach [1795-6; iv.481], thinkers enquired as to what, pragmatically, should be done with this tension between singular event—“a volcano, a deluge, a comet, &c.”—and lawful subsumability. The standard solution was, rightfully, to put this down to our limited perspective and consequent faith in some as-yet-undiscovered higher-order uniformity that subsumes lower-order exceptionality. Nonetheless, as we have seen, ontologizing and hypostatizing this *faith* (which is exactly what it is) does away with responsivity and receptivity to contravening data, consequently blinding inquiry to the genuine and important signs of upheaval within physical history (uniformitarian doxa, indeed, led Charles Darwin to entirely deny Mass Extinctions [1859; 318]:

²² Outlandish as this may seem, we note its resemblance to the contemporary cosmology of Unger & Smolin [2014]: therein, they argue for an ‘*inclusive reality of time*’ as a time in which laws themselves emerge and dissolve. There is a running history of such positions, e.g. Boutroux [1874].

holding unmistakable biodiversity losses *entirely* as artefacts of incomplete fossil data).²³ And yet, as we are about to see, the opposite route (of doing away with this faith entirely, as Cuvier did) destroys all motivation to colligate contravening data under new—more robust—explanatory models. Thus, whilst indeed making room for the contingent advent of extinction (by disarticulating substantive identification of justifications and existences), Cuvierianism simply could not gain traction upon the mechanisms and dynamics behind it, and, thus, not decrypt any meaningful (i.e. predictive) lessons regarding our own position or precarity (thus, isolating ‘existential precarity’ from any practical significance such that it remains propositionally inert). Or, it could only allow extinction insofar as it was rendered explanatorily—thus also pragmatically—meaningless.

Nonetheless, Cuvier’s step forward was in allowing the minimal plausibility of human extinction (even if his outlook could not allow it to accrue the predictive significance that, ultimately, alone grants it its unique expressive force): and this step, though ultimately overreaching, was found in his utter subtraction of justification from existence.

Cuvier spoke of “upheavals, ruptures, and fissures” in nature’s causal order—of “sudden and violent” and “great and terrible events” [2008; 190-2]—as true and irreducible saltations within reality’s etiological fabric. The “revolutions that have changed the state of the globe have been sudden”, he intoned [2008; 85]. In this, the catastrophist’s ruptures and advents (the “various catastrophes of our planet” [2008; 189]) operated to break the various anciently-held presumptions of some *substantive identification* between presuppositions of reasoning experience and facts of independent existence (an

²³ Hume himself [1992; 37] embodies this overreaching ontologization by outright claiming that “[t]here can be no such thing as *Chance* in the world”: only “our ignorance [of] real cause[s]”.

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identification which vouchsafed confidence in nature’s exhaustive compliancy with analysis, via rational demonstration, or sense experience, via empirical investigation). Principles of sufficient reason and continuity, alongside dictums such as *ex nihilo nihil fit*, had long been assumed to be exhaustively embodied within nature’s own ontological fabric: playing out as conviction in long-held metaphysical presumptions such as ‘becoming’ and ‘plenitude’.²⁴ Cuvier, in what can be safely deemed groundbreaking fashion, rejected all these presuppositions and their symptoms. Foreswearing the *ex nihilo* dictum, for example, he proclaimed “the cause was thus as sudden as its effect”. He was explicit: one cannot “explain earlier revolutions [by] present causes”; and this is, simply, because nature is “found to be subject to new laws”. Again unabashed, Cuvier wrote:

The thread of operations is broken; nature has changed course, and none of the agents she employs today [are] sufficient to produce her former works.
[2008; 184-93]

Where previous thinkers (e.g. Sade) had gestured beyond the plenitudinarian worldview by ‘reoccupying’ its conceptual parameters, here was the entire system’s indiscriminate negation. Overall, our “*creation actuelle*” is just one amongst many (entirely etiologically segregated) world-orders, each marked by “monuments” of the “great and terrible events” isolating them from each other. Indeed, these ‘worlds’ do not become or evolve—developing continuously and determinately one into the other—but are entirely causally and indeterminately disconnected: erupting into and out of existence

²⁴ ‘Plenitude’, as should now be clear, enforces nature’s maximal legitimacy by ensuring that what is legitimate never is *not* eventually and exhaustively realised. ‘Becoming’, on the other hand, upholds infinite divisibility of events into justifications (or, at least, connections) by way of determinate negation. In other words, all variations connect or relate one item to another (‘X becomes Y’ because ‘Y’ is the determinate negation of ‘X’), such that nothing *just is* (or, for that matter, *just is not*) isolated of all determination by way of other existing or potential things. By making all existents relational, determinate negation (and its mobilization as ‘becoming’) ensures nothing ever falls out of a wider, syncretic natural order. Both example ontic reification of regulative maxims.

without warning.²⁵ In this, Cuvier realises Hume’s sceptical problem of induction not as an epistemic predicament but as a realist ascription of nature’s lack of uniformity or law. Indeed, previously, and in order to support his skepticism concerning modalities, Hume (though himself ultimately utterly confident with faith of “custom” in “greatest regularity” [1992; 58]) had insidiously pointed out that “[w]e can at least conceive of a change in the course of nature”: of it “not being—or continuing to be—uniform”; which “sufficiently proves, that such a change is not absolutely impossible” [2003; 64].²⁶ Cuvier simply called the bluff on this latter assertion, transposing it from epistemology to ontology.

Tellingly, it was in these terms that Cuvier’s geologist opponents also conceived of the problem: themselves echoing passages from Hume’s argument from conceivability, whilst couching the debate in terms of rupture of nature’s nomic structure.

Lyell, for example, explicitly denied postulations upon “dissimilar order[s] of nature” that would be “governed by rules [entirely] independent of those now established” [2009; i.86]. Hutton, Hume’s fellow alumni of Edinburgh enlightenment, decried such conjectures on the basis that “[i]f the stone

²⁵ We note that Cuvier was writing before Hacking’s statistical ‘taming of chance’ in the mid-1800s. Certainly, the nineteenth century ‘erosion of determinism’ that Hacking identifies [1990] did not give way to untrammelled contingency but to contingency’s regimentation within aleatory constraints—i.e. limit theorems and probability fluctuations. *Chance is a containment of contingency, not its expression*. In this, Cuvier stands, possibly, as a curious artefact and last exemplar of an elder type of contingency that has since been largely eclipsed. As Massie writes, ‘does statistical probability fulfil the function that was once assumed by contingency? Have we not lost something[?]’ [2011; 12]. Loss or not, it is on ample display in Cuvier. And, in this, Cuvierianism comes to resemble some of the scholastic ontologies of voluntarism touched upon in Chap.4.

²⁶ For Hume, this was merely intended as proof of empiricism: we only have ‘certainty’ in lawfulness from observation. Hume presumes non-uniformity evidently false, because, if nature changed course, we would surely have witnessed this. (Of course, the ensuing discovery of deep time complicated this.) Hume, indeed, presaged Huttonian uniformitarianism [Dean, 1992; 18], opining that “irregular events” only provide proof of our ignorance of nature’s “secret operation” [Hume, 1992; 58]. Despite his own confidence, however, Hume had opened a can of philosophical worms.

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[which] fell today where to rise again tomorrow, there would be an end of natural philosophy [and] we would no longer investigate the rules of nature from our observations” [1795; i.297]. (This echoes Hume *Enquiry* almost verbatim, wherein he had pictured a “stone” that no longer falls when “raised into the air”, signalling thereby “an end” to the “chief part” of human knowledge and inquiry [1992; 18-28].) In wider discourse, Malthus [1992; 51] castigated his opponents as foolishly believing that natural laws are “fickle and inconstant” because they affirm “they will change” as Earth is in its “infancy”. (Such accusations are perfect demonstrations of contestation of the very lexica of natural nomology attendant upon the ongoing coalescence the first truly historical perspective on nature; where, in this conceptual climate, old definitions came under stress, and their semantic boundaries demanded antagonistic renegotiations.) Nonetheless, it is appropriate that Cuvier himself waxed very Humean when he promised his system is the very “embarrass[ment]” of “metaphysics itself” [2008; 57].

Cuvierianism thus stands as the indiscriminate negation—rather than mere internal reoccupation—of the plenitudinarian system and its assumption of substantive and foundational identity between autonomous existence and the functional principles presupposed by sapient experience and consciousness. It is the ultimate destitution of ‘amniotic world-physics’: of plenitude, continuism, sufficient reasons, interminable containment, and infinite translatability of existents into a ligature of connective justifications. For, representing the very nucleus of classical metaphysics, these substantive maxims (all subsumed by the master-maxim that ‘*to be*’ is to be ‘*maximally justified*’) are present, in more or less unbroken fashion, all the way from Parmenides to Leibniz (as we explore in the

next chapter).²⁷ Catastrophism, arriving at the closure of the grand metaphysical epoch, dirempted all remaining identifiability of existence with any residually reified judiciality (even those residua remnant within empiricisms such as Lyell's): doing so by entreating utterly indivisible scissions in nature, whilst thusly dismembering philosophy's long-running carnation of nature as (nothing but) somaticized jurisprudence. In voiding all nomic structure from reality, catastrophism produces a 'naturalism without nature' which—in this very subtraction of categorial limits—first emancipated geohistory from any empirical or actualistic constraint; by corollary, and by intensifying the notion that naked existence is not in any way inherently epistemically contentful, catastrophism demonstrably lubricated conceptualisation of human precarity across contemporary culture (as seen with Byron and PBS). Put simply, *nature was no longer inherently compliant with either rational demonstration nor sense experience*. Yet, by any feasible criterion of explanatory value, this was, at very best, a Pyrrhic victory. To fully appreciate why, we must cover how Cuvier came to this view.

Cuvier's radical stance on nomology arose from "applications of comparative anatomy to the history of the globe" [2008; 170]. That is, on brute appearances alone, the fossil record seems to present a picture of grand saltation and epochal hiatus. Taken on face value, this would appear to evidence just that: genuine breaches in nature's causal and nomic fabric across history.²⁸ Cuvier, precisely in this fashion, appears to have conceived of each new wave of genera as appearing *ex nihilo* in response to

²⁷ And many persist (albeit in inverted form) within the core mantra of post-Nietzschean continental metaphysics: that to '*be just*' is just to '*maximally be*'.

²⁸ All things equal, this was not an unwarranted abduction, given contemporary knowledge: through comparative anatomy's "*conditions d'existence*" there was strong appreciation of the fine-tuned calibration of each species to its habitat; yet, there was no viable theory of a causal mechanism that could accommodate such tight co-dependency across time; add to this palaeontology's clear evidence of epochal abruptions and one could 'easily' arrive at Cuvier's conclusion of causal saltation.

nomological ruptures. Accordingly, he proposed such emergences as etiologically inscrutable: as Rudwick [2008; 178] notes, ‘the reptiles [...] simply “began to exist” at a certain period’. Pointing to the event of the abiogenetic appearance of life, Cuvier spoke of it as an arch-catastrophe—catalogued as equivalent to geohistory’s earth-shuddering “upheavals”—wherein we can unmistakably read the inscription of its abrupt emergence within the stratigraphic record [2008; 190].²⁹ Thus, in a way, the “tearing and upheavals of beds” (so easily dismissed as immature pyrotechny in Lyell’s [1881; ii.3] disabusal of Cuvier’s “paroxysmal theory”) are mere vehicle for catastrophism’s larger contention concerning organic development: “great events” are conscripted simply because they are, Cuvier writes, “necessary to bring about the major [organic] differences I have recognized” [2008; 186].

This gets to the heart of the matter. Cuvier admits unobserved entities (i.e. his palaeobiological reconstructions of ancestral ecosystems), doing so readily (inasmuch as the catastrophist scientist faithfully follows nature’s brute signs *whatever* they imply [Baker, 1998; 179]), but only insofar as they are ‘immediately attested’ by sense-data alone (“Show me the bone!”). We have, of course, demonstrated how utterly nothing about this ‘attestation’ is actually pure or immediate, yet, blind to this truth, Cuvier’s radical empiricism allows such unobservables *only insofar* as they are entirely atomised facts-of-existence that are thus isolated from the wider theoretical-inferential network—of chronological and modal relations, alongside their attendant counterfactual implications—that would grant them meaning as happenstances *within a history*.

Shorn of this implicatory network, historical differences within natural order become unbreachable hiatuses between entirely different natures (hence, the ubiquity of the “worlds” metaphor). In other

²⁹ We note the curious similarity of this to the contemporary ideas of Meillassoux [2006 & 2016].

words, if we follow nature's brute signs—without any regulative framing not immediately present within the signs themselves—then it is inevitable that all *explanation* is reduced to mere *labelling* and nature should thereby appear as a congerie of ruptures. Cuvier's system, indeed, is not just the 'embarrassment of metaphysics' (which is a step forward for science) but also, inevitably, of physics (which, of course, is undesirable). For Cuvier rid himself of the explanatory framework that alone motivates us to apprehend descriptive incoherences (between incoming data and prior hypotheses) as reasons to update etiological models rather than simply revocations of aetiology *überhaupt*. Rid of this motivating principle, robust explanation is reduced to mere labelling, and richly "Ætiological Geology" collapses into blindly "Descriptive Geology". Thus, where Hutton reified the regulative ideal of parsimonious inferences, Cuvier himself mistook corrigibility at the level of explanatory model for contingency at the level of natural law. (As Lyell wryly noted, "the discovery of the satellites of Jupiter [shouldn't] be regarded as a physical event in the history of those heavenly bodies" [2009; i.163].) These twin errors arrive because both empiricisms, in ignoring the *meta-descriptive role* of the rational principles presupposed by objective description, could not help but mistake these principles of reasoning for descriptive objects themselves, and, correlatively, could not help but hypostatize functional features of empirical inquiry as independent natural realities (whether the function reified be 'colligative parsimony' or 'theory update', respectively). Shortly, we will begin to cover exactly what it means to be 'meta-descriptive'; to close the section, however, we note the consequences of Cuvier's stance *apropos* the enunciation of X-risk.

Just as Hutton discovered deep time by erasing 'temporality', Cuvier enunciated natural history by eliminating 'historicity'. Cuvierianism, indeed, licensed postulations of vastly divergent worlds—up to

and including radically nonhuman ones—but *if and only if* they are utterly causally isolated one from the other; thus, shorn of the consequential relations that would thread them into legible history, they fail to support anything resembling a practicable scientific prediction nor even a practical call-to-action concerning our own oncoming future. Inasmuch as serious futurology presupposes historicism [Rescher, 1998; 26], we note that, in eliminating ‘history’, catastrophism simultaneously subtracted all meaningfulness from ‘futurity’. Rent of the (subjunctive) relations of consequence and implication that alone grant futural propositions predictive and practical weight, the prospect of ‘X-risk’ remains propositionally and pragmatically inert—and, thus, largely meaningless. Accordingly, we ask: if subjunctive locutions are not natural, yet are entirely necessary, then what are they?

4—CONCLUSION: INTELLOGENIC CATASTROPHE

Both Lyell and Cuvier grasped the shape of terrestrial history incorrectly (for similar reasons; yielding dissimilar errors) because they proscribed for themselves the explanatory tools by which to *locate* reason’s position within it as finite witness. This is why the story of early geoscience is so germane to the history of X-risk sensitivity: even whilst uncovering multifarious empirical ‘facts’ signalling the spatiotemporal parochialism of intelligence within the earth system (e.g. hints towards species mutability or deep time’s evident lack of inborn hospitality to human value), neither geothorist could properly nor coherently ‘see’ these facts as such. This was because of underdeveloped understanding of the nature of semantic framework within which any such ‘fact’ must hang in order to be grasped as in any sense discursively meaningful. We have seen how the relations (primarily modal) that make up this ‘discursive network’ were incapable of being fully rendered or explained as direct empirical objects (as

Hume noticed concerning law-statements). Said network is therefore not straightforwardly natural (*contra* Hutton and Lyell’s backsliding tendency to treat it as such), yet neither is it expendable when conducting natural inquiry (*contra* Cuvier’s hasty rejection of explanatory vocation): put differently, certain concepts are utterly necessary for natural description, yet neither do they directly describe nature or natural objects themselves, and this, put simply, is because they instead articulate matters of ‘*ought*’ rather than ‘*is*’ that, though thereby irreducible to declarative matters, are nonetheless requisite for any factual declaration to be adjudicated and evaluated as in any way ‘correct’. The usage, that is, of any empirical descriptive concept presupposes further, non-descriptive concepts through which one discriminates apposite and inapposite use-cases. These concepts are ‘metaconceptual’: they are necessary, yet not natural—and neither are they at all supernatural—and this can be the case because they are instead *normative*. Transposed into the terms relevant to geohistory: our nomological conceptions cannot be transparently natural, as they are evidently fallible and heuristic, yet this does not mean that we can reject them if we want to be *motivated* to understand nature ever better. They are theoretical models—and models aren’t infallible microcosms—yet they are nonetheless mandatory for model-based minds such as ours.

Lyell, considering the “enormous” changes mankind has wrought upon the planet, was led into quandary. Given undeniable absence of human fossils—and thus our “modern origin”—Lyell remarks of humanity’s vast planetary “influence” (i.e. our tendency to reinvent ecosystems and terraform continents) that it must represent a clear “deviation” from prior “uniformity [in] the course of nature”. Accordingly, the geologist asked “[i]s not the interference of the human species” a rupture that might “destroy [our] confidence in the uniformity [of] nature, both in regard to time past and future?”

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If such an innovation could take place after the earth had been exclusively inhabited for thousands of ages by inferior animals, why should not other changes as extraordinary and unprecedented happen from time to time?

[2009; i.155-6]

Anthropogenesis—utterly breaching prior regularities—seems suspiciously close to rupture. Lyell attempts, in well-worn habit, to venture that humanity’s influence “deviate[s] far less from [that of] other animals than we usually suppose”; but, given that this denudes the conviction, firmly held by Lyell, that “man is of higher dignity than were any pre-existing beings on the earth”, he cannot take this route. Thus, Lyell is seemingly left with no other option than to evince reason’s emergence as ‘catastrophe’ *par excellence*.

Thereafter thought-experimenting upon an extraterrestrial being observing our planet from afar, he enquires whether the “intervention of such a peculiar and unprecedented agency long after other parts of the animate and inanimate world existed” would truly appear as a break in the “permanence in the laws of nature” and the “regularity of the system”? *No*, he concludes. Since, though it undeniably has ramifications throughout the bio- and lithospheres, the “new and extraordinary circumstances” of rationality’s emergence are ultimately innovations not “of a *physical*, but [of] a *moral* nature”, and so, Lyell’s answer is to cite total separation between “moral and material worlds” [2009; i.163-4].

Lyell obviously meant this in a naïve and metaphysically inflated fashion (which only shunts the question of unjustifiability to a higher echelon, insofar as dualisms are nothing but unjustified distinctions). And yet, again, there is a kernel of truth. It remains to be seen whether humanity’s daring adventure will or won’t be a dead-end disaster for our biosphere, yet it cannot be denied that intellogenesis marks a significant departure. This is not because intelligence is supernatural (as Lyell likely intends), nor because it breaks ‘the ordinary laws of nature’, rather, it is simply because it involves questions of ‘*ought*’ semantically irreducible to ‘*is*’ [Floridi, 2017; 280-5]. Or, issues of ‘*should*’ (being

characteristically concerned with ‘everywhere’ and ‘everywhen’) that are constitutively detached from simple declarations of ‘*are*’ (which concern themselves merely with the ‘here’ and ‘now’): its constitutive orientation toward such horizons, indeed, explains intelligence’s tendency not only to populate the planetary totality but also, as Lyell notes, to radically redesign it. Indeed, insofar as it is oriented toward unconditional horizons in this way, reasoning can never be happy with any merely local criteria of correctness (such as ‘sense reception’, ‘common sense’, or ‘arbitrary institutions’) such that it commits itself to the scientific labor of artificialization and, thus, *turns the manifest world entirely to theory*. (Indeed, from Lyell’s day until now, modellings of earth-systems have moved from table-top miniatures to the contemporary megastructures of planetary computation.) This is what Carlyle’s image so intuitively captures: in making the world a dumpling, one has already expatriated oneself from *all* worldly horizons. And yet, this is not axiologically deleterious, inasmuch as it is nothing other than the resolute pledge of uncompromising committal to the norm of truth.

Knowing is irremediably artefactual, because not all knowing can be natural, insofar as ‘knowledge’ is itself a normative adjudication.³⁰ And yet, because intelligence therefore concerns *values* that are not *facts*, it finally becomes coherent to discuss the ‘catastrophe’ of human extinction *in precise conjunction* with the fact of the ‘uniformity’ of widest nature in our absence. In other words, it is directly attendant upon the fact that to classify something as having ‘mind’ is properly to proffer a normative, rather than factual, evaluation that we can talk of the *fact* of the extinguishment of all mental *values* without problematizing the regularity of the rest of nature forthwith. That is, only by extricating ‘fact’ from

³⁰ Classifying an episode as ‘knowledge’ is a *normative judgement* concerning its *propriety* [Sellars, 1997; 76].

‘value’ can we synthesize the truth of catastrophism with that of uniformity. Because ‘human extinction’ is a disaster and paroxysm *only* within the conceptual order of reasons and values: for, once again, the distinction between ‘catastrophe’ and ‘regularity’ is irreducibly *one of evaluative perspective*.³¹ It is, indeed, because we have concepts to talk *about* concepts—and thus remark on conception’s limitations—that we increasingly are able not only to better understand the expanses of cosmic space and time but, accordingly, understand our placement and precarities within them.

Indeed, before we move onto the next chapter (wherein we recount the long-range genealogy of understandings of knowledge’s metaconceptual functionality) we fast forward, to the late 1850s, to an elder Lyell. Here, in private notebooks, the scientist works through his reactions to increasingly undeniable evidences of evolution. By this stage (and given his proximity to Darwin’s theorisations on biological progressivism), there is no room for cyclical resurrections. Therefore, considering the “millions of years” of “extinction & new beginnings”, Lyell admits that nature’s law is “the same for Man & Animals” [1970; 200]. “If [evolutionary] progress be true we must look [at] the whole prospect in the face” [190]: we can no longer accept “the noblest work of Nature is her last” [180]. Accordingly, Lyell speaks of “future more perfect and more intellectual beings” which will surpass our “complexity of organization” as much as the “humble lichen” is surpassed by “the most highly developed flowers”. This, he solemnly intones, is “a future paradox from which our race shall be excluded” [187-8]. (Notably, such candid asides are absent from his next, and final, publication: a consideration of man’s

³¹ Swift on the heels of the Alvarez hypothesis for the K-Pg extinction event, Raup & Sepkoski [1984] proposed that seemingly irregular impactor events are undergirded by larger regularity regarding a ‘Nemesis star’, in twin-orbit with our own, dragging thousands of deadly comets into our stellar vicinity at predictable periodicities of 26Ma.

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place within evolution [1863].) Thus, from revenant dinosaurs all the way to human terminus, geohistory had matured (Lyell's obvious residual attachment to teleology notwithstanding). With this field intact, all the requisite scientific vocabularies were consolidated and available for fully articulating existential threat and terminus: we now turn to the theoretical labours—upstream from empirical investigations—that had first allowed this consilience.

‘TOTO MUNDO DESTRUCTO’: the PREHISTORY of FUTURE EXTINCTION

In the teaching of natural philosophy, I cannot begin better than from privation; that is, from feigning the world to be annihilated.

—Hobbes

0—INTRODUCTION

Conceptualizing our own extinction always involves reflection upon the propriety and place of concept-use itself—namely that concepts are limited because reality is not conceptual in structure—*before* it gains any empirical-level determination as prospective fact, whether triggered by microbe or meteorite. It is tacitly reflective first, only acquiring declarative content afterward. All explicit description of human extinction, in other words, implicitly involves higher-order cognizance regarding the limits of human thought: concerning pragmatic metacognitions, prior to its procurement of factual dimensions.

Thus, though it was given objective purport and descriptive range—thus becoming fully explicable—by way of the consilience of the empirical-level vocabularies established across prior chapters (i.e. geoscience, modelling, demography, probabilism, risk-awareness, etc.), the articulation of extinction was additionally consequent upon *metaconceptual* resources that do not directly describe empirical data (because they instead concern the concepts that allow us to talk *about* concepts). The empirical vocabularies were, in this way, necessary yet not sufficient. Accordingly, we can trace the implicit sources of extinction’s articulation further back than may immediately be chronologically obvious (at least at the level of Chap.2’s *de facto* catalogue of explicit scientific forecasts concerning existential threats). This is why, in addition to other avenues, there remain

uniquely philosophical ‘conditions of possibility’ for the discovery of X-risk, stretching yet further back into intellectual history. (As ever, empirical-descriptive inquiry unfolds in inseparable feedback with theoretical-conceptual elaborations.) The current chapter is the exploration of the long-range conceptual labours requisite to X-risk’s eventual enunciation.

Fundamentally, this is a question of *modality*. That you are reading this entails that human extinction currently remains purely potential: a risk rather than reality, and thus expressible only through modal terms like ‘possible’ or ‘contingent’. It is premised upon our aptitude at conceptualizing objects, causes, and events that are, to us, ‘merely possible’ insofar as they are constitutively unexemplified within experience. Yet it is a question of modality in the subtler ‘metaconceptual’ sense touched upon above. For all prognostication upon unobserved possibilities—up to and including the possible end of observation—is necessarily complicit, again, with self-reflections upon the positionality of observation itself: as we explore below, one need first express experience as limited in order to experience the unexpected *as* unexpected. And the everyday tools that facilitate such higher-order metacognitions are *modal locutions*. Modals, then, play a surreptitiously dual role: they not only express our grasp of the contingency of things (the focuses of Chap.2 & 3) but also the contingency of our ideas *about* things. The latter usage, however, was not understood or well-developed for a very long time, which prohibited articulations of human extinction (insofar as ‘extinction’ paradigmatically requires combination of these two expressive roles, *qua* convergence of both ‘aleatory’ and ‘doxastic’ understandings of risk: exemplified, respectively, by grasp not only of the instability of the natural world but, also, infirmities within the conceptual frame through which we necessarily experience said world). Postulating future

possibilities beyond prior expectation—and *a fortiori* a future bereft of any experience at all—is as much a question of the latter as the former and, accordingly, is attendant upon a long-running and hard-won series of philosophical clarifications.

The Ancients allowed modality only a narrowly fact-stating role, such that all that modals could express was global correspondence between our concepts and nature, which, inhibiting articulation of a distinction between our conceptual frame and ontic nature, was a prohibition that, by consequence, also limited the remit of the naturally possible to within the range of empirical experience. (Thus, exotic possibilities like X-risks are fundamentally barred.) This modal theory motivated, and was motivated by, the prevailing presumption throughout ancient philosophy that the *only* legitimate concepts are the ones that correspond directly with existence: instituting an explanatory circularity that serves as the unjustified justifier—or ‘*mythical given*’—announced by Parmenides as the identity of thinking and being (an injunction that makes propositions upon the non-existence of thought literally null).¹ By limiting ‘the possible’ to ‘the experienced’, moreover, not only was a future without human experience foreclosed, but so too any meaningful future at all: insofar as no robust distinction could be granted between horizons of expectation and of experience.

By rarefying modal terms from basis in actual experience in the pursuit of theologies of omnipotence, medieval schoolmen and Arabic theologians accidentally relinquished modals from

¹ The ‘*mythical given*’ or ‘*framework of givenness*’ was Sellars’s [1997] pathbreaking identification of the foundationalism (rife across both historical and present-day spectra of philosophy, all the way from positivist empiricisms to speculative idealisms) that presumes ‘the space of reasons, the space of justifications and warrants, extends more widely than the conceptual sphere’ [McDowell, 1994; 7]. *It is the uninspected assumption that something non-conceptual can—without any conceptual mediations—grant us a conceptual reason to properly count as thinking anything thus and so.*

their previous restrictively fact-stating role and serendipitously allowed them to instead assume an expanded role stating the corrigibility of factual representations themselves. Instead of expressing only undying identity between our concepts and reality *across* time (as plenitude does), modals could now track the infirmity of concepts relative to reality, and thus, eventually, the senescence of concepts *within* time. Though not yet apprehended as a ‘real threat’, this idea of conceptual precarity first became expressible as a ‘possible world’ during this period. We will discover, indeed, that a tacit relation exists between counterfactually imagining a world stripped of any concept-use (a possible world wherein sapience is non-existent and there are *no* human subjects) and the expression of *any* coherent realism that embeds within itself robust distinction between reality and our expressions regarding it: the implicit condition of scientific realism is imagining a world stripped of human apperception; thus, as we shall see, though explication of extinction as empirical-level prognostication is available only much later (cf. Chap.2), it remains conspicuously implicit within modernity’s very origins *qua* the late medieval seedbed of scientific inquiry.

With these medieval developments, ‘contingence’ became reflexive or recursive, and rationality duly became responsive to the jeopardy of its own domain. This catalysed the localization of cognitive content, or enunciation of finitude, thus initiating philosophical modernity. Yet, inasmuch as this triggered the modern sceptical tradition, it also triggered an Early Modern search for new epistemic foundations, which, insofar as they re-grounded discursive sapience variously in intellectual intuition or sense perception, consequently regionalized the reflexive reach of metaconceptual contingence and accordingly could not coherently imagine a reality entirely without concept-use: dogmatic rationalism re-mortgaged the idea that concepts were part of existence, concordantly inhibiting

propositions upon a concept-forlorn reality; whilst empiricist scepticism jettisoned the conceptual—namely modal—resources that alone allow articulations of finitude to cover not just the sensibly unobserved but the counterfactually unobservable (e.g. the end of sensation as such). Either way, explicit statements upon human extinction remained philosophically elusive. It was only with Kantian critical rationalism, with its outright rejection of epistemic foundationalism and redefinition of rationality as self-legislature, that reason became culpable for the exhaustive entirety of its contents—such that, subtracted from all foundation in umbilical existence, sapience understood itself to exist *by and through* its exhaustive liability for itself—and, accordingly, growing responsivity to the potential senescence of human rationality’s enterprise was precisely coincident with reason’s redefinition of itself as a form of self-responsibility and course-correction. Or, as we shall see, Kant’s globalization of critique and totalization of practical culpability *just is* dawning cognizance of X-risk as the ultimate statement of regulative, future-oriented culpability. This is, then, is the story of how the future perfect entered science.

1—FUTURES LITERACY: THE MODERN BACKDROP

Extinction-severity scenarios are a special case within a generic class of events available *only* as forecast, or, in *futur antérieur* tense. Such items, or ‘futuribles’ [Jouvenal, 1967], increasingly populate our practical and theoretical horizons. As already indicated, late modernity is progressively ensnared by them across the board. Bexte [2011] identifies this as consequent upon a ‘paradigm shift’ toward ‘futurism’—attendant upon scientific institutionalization of the structure of anticipation—occurrent

across the previous two centuries.² In the twenty-first century, anticipatory forecast indexes a properly scientific enterprise—transacting in predictive rigor capable of undergirding policymaking and macrostrategic planning—yet this late modern bureaucratization and mathematization of forecast is itself conceptually dependent upon the earlier inauguration of historicism. I concur with Rescher when he stresses that ‘serious futurology’ necessarily ‘presupposes history’ [1998; 26]: ‘[o]nly for those who take historical change seriously does the question of predicting the future become a matter of real concern’. Of course, it was Koselleck [2004] who influentially argued for the modern

² Scientific foresight emerges, during the nineteenth century, from powerful confluence of 1) probabilism’s formalization of stochastic events and 2) calculus’s transposition of natural processes into time-stepping procedures. Outsourcing intuition to arithmetical “calculations”, indeed, is what allowed Montesquieu to produce the first long-term forecast on human extinction. Mid-eighteenth century, Maupertuis proclaimed that our future-oriented faculty of “*prévision*” is just as capable of open-ended update and technical improvement as our historical understanding of the past [Jouvenel, 1967; 12-3]. Laplace’s thought experiment on his namesake daemon took this to extremes, expounding a motivating, if fundamentally impossible, benchmark for predictive perfectibility. Following Condorcet’s suggestion of “social mathematics” [Daston, 1995; 104], planning was applied to social policy: after nineteenth century beginnings, this practice exploded in the early twentieth century as the twin turmoils of economic depression and World War demanded largescale state planning (or, ‘*intelligence*’) in matters social, economic and military. The bureaucratization of the future was underway. Due to technical developments (from advances in computation to emerging ‘systems theory’ and ‘operations research’) the postwar era betrays untrammelled ‘preoccupation with the future’ [Rescher; 1998; 28] alongside ‘rapid expansion, institutionalization, and exploitation’ of ‘model-based prediction’ [Heymann et al., 2017; 31-2]. Soon afterward, in the 1950s, largescale meteorological forecasts first become practicable [Gramelsberger, 2011b]. The trend is exemplified elsewhere in wargames and 1945’s establishment of the RAND Corp. Around this time, econometrics also take off, with banks and governments soon establishing modelling departments. Ossip Flechteim, in [1966], baptizes ‘futurology’ as a ‘new science’. Subsequently, against a Cold War backdrop, game theoretic projections upon arms determent dovetail—by way of detailed prolepses of nuclear winter—into wider ecological prognostics regarding global climate. *Limits to Growth*, alongside other similar works [e.g. Forrester, 1973], soon entrench planetary-scale modelling in the public consciousness. Indeed, one could argue that the seeming invisibility of ‘mutant’ disciplines like cybernetics or futurology within present-day institutions is due, not to their stillbirth in the previous century, but, instead, to their universal saturation of our perceptual field.

experience of history as emerging across the “*Sattelzeit*” of c.1750-1850, wherein the ‘space of experience’ became dislocated from the ‘horizon of expectation’. Simply, one must be historicist to anticipate the future as uncertain and open, where this, in fact, provides the *very motivating pressure* behind efforts to mitigate this incertitude with prognostic efforts. Such openness is, itself, premised upon acknowledgement that the ‘space of experience’ cannot exhaust the range of possibility. And this is exactly what distinguishes modern forecasting from the perennial tradition of expectation in the form of eschatology.

For, whilst chiliasm augurs events never yet observed, such apocalyptic prophesizing licenses such events precisely by way of upholding a naïve belief that the *entirety* of cosmic time is *infinitely divisible* into meaningful content and, therefore, ‘meaningfulness’ and ‘chronology’ are inseparable and congenital such that any ‘time’ before or after hermeneutic or intentional content is strictly unthinkable. In this schema, ‘meaning’ is infinitely included within and by ‘time’ (and *vice versa*). Indeed, ‘apocalypse’ translates ‘chronology’ as *mere latency* upon the full disrobement of moral significance. In contradistinction, the very pragmatic occasion of modern prognosis is the conspicuous loss of this supportive edifice. The integral difference here, therefore, is that forecast is a roadmap that operates by reflexively incorporating its own status as mere map: thus, crucially, it first allows room for that which is entirely beyond its own range of anticipation. Or, in other words, it first lubricates sensitivity to nature’s catastrophic capacity to contravene all expectation and to render the unexplained, unprecedented, and unexperienced (this, as we soon see, not only instates modernity’s acute sense of disaster but, concomitantly, provides the founding motivation for science’s self-correcting project). Prognosis, as opposed to prophecy, embeds its own infirmity within itself as

newfound receptivity to the arrival of the entirely unexpected, and yet, through this, we see that the ‘first’ catastrophe was necessarily cognitive and practical—rather than objective and empirical—in its dimensions. That is, experiencing the unexpected isn’t just an empirical event; it is, in fact, self-infliction of the logically anterior awareness that our experiential limits do not exhaust reality.

By corollary, before it gained any historical substantiation during Kosellec’s *Sattelzeit*, the postulation of possibilities entirely beyond experiential horizons was, as needs be, a purely metacognitive affair prior to being concretely historicized and tensed. Again, ‘extinction’ involves self-reflection *before* it acquires objective range, just as finitude is tense-agnostic *before* it becomes tensed, across modernity, as incoming disaster on the horizon.³ This, indeed, is the germinal cognitive seed of our modern ‘accidental megastructure’ of planetary-scale computation, prediction, and mitigation [Bratton, 2016]. We trace this long-durational prehistory throughout the philosophical elaboration of our metacognitive resources concerning the limitations of our own cognitive frame, insofar as this self-elaboration provides the original motivating occasion for what latterly became our present-day worldwide infrastructure of prediction, and it did this by way of giving ‘ignorance’ concrete dimension—and pragmatic stakes—as incoming disasters. In other words, the history of the future is the story of how contingency became self-reflexive; and the eventual specification of ‘X-risk’ is duly unveiled as paradigmatic—or, essential rather than accidental—to this modernity-initiating drive.

³ Finitude is *always* both theoretical and practical: we learn, again and again, that ignorance leads to catastrophe.

2—THE FIRST UNIFORMITY: ANCIENT OBSTRUCTIONS

To forecast a world without experience, one must first be able to model the world as being otherwise than it is experienced. The latter is condition of the former. This is why locutions upon ‘extinction’ and ‘simulation’ share a conceptual ancestry and do so non-trivially.

Simulation (here indexing a mental episode involving representations that are realistic yet not mimetic, or, in other terms, are ‘counterfactual’) is a venerable cognitive pursuit—predating both computer and calculus, insofar as, historically speaking, simulation was simply delegated and outsourced to these ‘prostheses’. Tracing the history of this ability (to discursively picture the world as otherwise than it is experienced) allows us grasp upon the prehistory of what only much later became specifiable as ‘X-risk’ (expressions concerning a world without experience *überhaupt*). Or, the history of counterfactual reasoning is the prehistory of X-risk awareness.

Kant, in 1775, had written that, given “laws of attraction”, the philosopher could dynamically manufacture an entire working universe mentally [2012b; 197]. Yet earlier, Descartes [1985; 257] famously proclaimed the same: presupposing motion, he could ‘construct the universe’ as mind-based model [cf. Hegel, 1995; ii.247]. The argumentative force of both episodes (identically tasked with vouching for the plausibility of mechanistic laws) derives from a presupposed understanding that, given other parameters or starting conditions, the system would culminate differently. Both experiments presume responsivity, thereby, to the idea that the *world could be radically otherwise*. Earlier still, around 1225, Robert Grosseteste penned a theory of cosmogenesis: his delineation of the physical axioms and laws therein was so painstaking that a team of modern-day scientists have

recently ‘reformulated’ them numerically; having run computer simulations based upon these parameters, the researchers revealed Grosseteste’s world-model as acutely sensitive to initial conditions. In other words, the system can play out variously, in fashions diverging from the one Grosseteste intended (and scholastic metaphysics prescribed). Fascinatingly, Grosseteste himself was receptive to this: affixing ‘additional constraints’ to his theory to guarantee that—in spite of other possible pathways—his universe reliably plays out precisely as Ptolemaic cosmology requires [Bower et al., 2014]. This clearly indicates that Grosseteste was cognizant of counterfactual scenarios and merely possible worlds and, what’s more, was alert (however rudimentarily) to their role in reasoning.

Recognition of the role and legitimacy of counterfactuals in inference, however, did not always exist; it was, as we soon see, only gaining ground during Grosseteste’s era; and the reasons for its prior absence are synonymous with the reasons why conceptions upon a world *sans* concept-use were likewise unavailable to the ancients. This was because the ancients presumed the only legitimate concepts correspond directly with existence. Presuming this to be so, there is concordantly no room to refer to scenarios beyond natural experience, and, by the same token, no capaciousness for rationality to refer to its own artifice, or, the fact that its categories, resources, rules and limits are not in fact identical with widest nature. Without counterfactual locutions, reason cannot grasp its own limits relative to reality—insofar as these constitutively fall beyond actual experience—and, thus, it *cannot but* encounter itself as fully exhaustive of and coincident with reality. Or, in restricting conceptions to correspondences, reason must be natural just as nature cannot be anything other than interminably reasonable. We must explore this ancient background so as to frame how the late-medieval accommodation of counterfactuals (*qua* legitimating artificial referents within inference)

unravelling as tacit sensitization to the artifice of concept-use *toto genere*. To appreciate this later ‘denaturalisation’ of sapience, one must first establish prior assumptions of its perfect naturalness.

3.1—parmenides, c.500 BC

Exerted meditation upon modality begins with Parmenides of Elea. Parmenides’ ontology (what there is of it, for its systemic reach is matched only by its thetic compression) is made up predominantly of modal claims. As we soon see, Parmenides’ prescription of a ‘necessitous’ shape to ontic matters is entirely downstream of self-reflections upon reason’s own ‘necessitous’ nature, which is what makes this first ontology pertinent in the prehistory of the pragmatic, metaconceptual resources under which reason explicates its own (terminal) finitude.

To briefly summarise Parmenides’ ontic commitments, ‘*non-being is not*’ and therefore no thing can possibly be otherwise than it is, because (via contraposition of this first claim) ‘*only being is*’ and thus everything is necessarily all that it can be [Parmenides, 2009; 52]. Or, *being=being*. The ‘=’ sign here encodes a ‘modal straightjacket’ of exhaustive self-identity, sealing Parmenidean “being” into strict, autarchic uniformity with itself as comprehensively “changeless”—fastened, as “ungenerated and imperishable” [64], within identity’s “coils of huge bonds” [72]. The Eleatic philosopher, that is, expunges all modalities other than necessity and all tenses other than the present from his system—whereby “becoming and perishing” are abolished [72]. Relevant to our interests is the fact that this grand act of ‘meontic hygiene’ serves as the primal scene for the long-term theory-level refusal of irreversible terminality and irreducible contingency within natural philosophy, setting the stage for the stymying of empirical-level appraisals of previous species extinctions for many, many centuries

to come (given readily available fossil evidence, geological data, etc. throughout the ages). Yet this prescription of object-tier “necessity” was arrived at by way of reflection upon epistemic concerns.

What is pertinent, that is, and what makes Parmenides’ influence relevant not just to prohibition of empirical-level termini but also to the conceptual prehistory of specifically human terminus, is that his ontology unfolds as a meta-analysis of truth: his cosmological denial of contingency, that is, unfurls by way of a higher-order commitment to the ironclad incorrigibility of conception itself. This double-aspect—instating an amphibiousness of epistemic and ontic concerns—is not accidental, as it secures Parmenides’ position as first practitioner of ‘metaphysics’ alongside his prime philosophical innovation: his explication of a correspondence theory of truth. For Parmenides, that is, knowledge is exhaustively based in acquaintance: ‘true knowings’ are rendered, exclusively, by unmediated contact with pure being; and, by corollary, all beings are immediately compliant and amenable with ‘true knowing’. And this is an epistemological commitment that *explains* and *is explained by* his ontological commitments. Or, modal terms must state immediate realities because our ideas can only correspond; and our ideas must correspond because modals can only state immediate realities. Pure biunity. The explanatory circularity here was mistaken for an inviolability or irrefragability that, in turn, was mistaken for substantive overlap between the two domains, which, thus serving as the first formulation of foundationalism in philosophy, licenses the resonant Eleatic injunction that “knowing and being are the same” [Kahn, 1969; 721]. This is the godfather of all appeals to ‘mythical givens’.

The key point here is that Parmenides cannot license “absent things” [2009; 60] in ontology (possibilities, subjunctives, future contingents: all absconded as “doxa”) *because talk of object-level contingents necessarily redoubles as concept-level contingency insofar as it requires grip on a distinction*

between our cognitive framework and its object-level contents because it would entail that not all concepts indiscriminately correspond without qualification. Yet because he doesn't allow expressions that do not immediately refer, he cannot habituate the modal expressions that allow us grasp on failures of reference (and, through this, allow us traction upon a distinction between our semantic frame and its objective contents) such that, instead, all that language (modal or otherwise) can express is global identity between our concepts and reality, and Parmenides must consequently state that our semantic framework *just is* objective reality. Existence must have a structure that corresponds with concepts because concepts must exist in order to correspond and *vice versa*.

Thus, the 'first uniformitarianism': an expulsion of time and mutability, but rather than premised on empirical regularities it is premised upon higher-order uniformity presupposed between noesis and existence. Thought \supset being; ergo, no extinction. Here there can be no termini—let alone any end of intellect—insofar as intellect *just is* existence itself and is so indeterminately and without further qualification. Indeed, the indeterminacy of their correspondence, directly motivating the Eleatic denial of perceptible object-level change and mutability, was the problem Plato inherited: how could one distinguish frame and object, holding that one was *not* the other, without jeopardising the *being* of either?

3.2—plato, c.360 BC

Plato invented the "Idea" as a requisite mediator between immediate perceptual existence and our conceptual frame upon it, yet insofar as he remained enthralled to his predecessor's presumption that all legitimate concepts consist in correspondence, he necessarily invented plenitude in order to mitigate for any temporary divergences between the two, allowing 'contingency' objective range but

only insofar as it eventually expresses—and thus is inevitably reducible to—a higher-level solvency and uniformity between our ideas and total being (because, simply, ‘all possibles must eventually be’). Thus, though he is able to rehabilitate ‘becoming’ from its Eleatic exile, it is pinioned to plenitude—communicative only of identity between reason and reality by way of reducing modal expressions to expressions of correspondence through the intercession of time—such that natural ‘becoming’ axiomatically cannot encompass a senescence of reason. Yet, nonetheless, in opening up the distinction between cognitive framework and immediate object, Plato laid the foundation for later explication of modal logic and, eventually, its clarificatory application to this very distinction: thus, this background is essential to reason’s much later discovery of its own worldly contingency as ultimate articulation of frame/object discrimination.

Key to Plato’s late work *The Sophist*, in its response to Parmenides, is the discovery of the distinction between “*ouk on*” or determinate negation (as in ‘X is *not* Y’) and “*me on*” or indeterminate negation (‘nothingness *as such*’) [Dunham et al., 2011; 19-24]. Wielding this new distinction, Plato notes that when we say something ‘is not’ we are differing it from *other beings* not from *being itself*: “it does not signify something contrary to *that which is* but only something different from it” [1993; 52]; accordingly, rest can be said to *not* be motion without jeopardising the being of either notion in-itself. This, then, demystifies and deflates Parmenides’ problem of “absent things”: or, why we can predicate negation upon determinate beings (thereby talking of becomings or contingences or “*agnoia*”) and remain veridical and adequate to being at large. Enter the Platonic Idea. Plato—intuiting that, in knowledge, presence is always mediated by absences—invents “the Idea” as crucial mediating faculty between cognitive intentionality and indiscriminate being: as a

framework, absent within present appearances, that nonetheless explicates salient features of presence, otherwise intangible or unclear. This introduction of mediation allows the object-level leeway for functioning modalities beyond brute necessity and Parmenidean stasis: ‘beautiful’ particulars can come and go (displaying contingency) without damaging ‘beauty’ itself; or, we can talk of determinate beings that currently ‘are not’, such as future contingents, whilst remaining adequate to indeterminate ‘being’. And yet this Platonic compromise only works by re-instating Parmenidean biunity at a higher level: any dislocations between frame and object are still nested within guaranteed higher-level correspondence; so that locutions upon the contingency of the frame *as such* are still comprehensively forbidden. *Contingency is objective, yet objectivity itself cannot be contingent.*

We use modal terms, that is, to express regional inadequacies between concepts and objects, but only insofar as this is mortgaged to a higher-order and exhaustive adequacy between the two: in other words, concepts can be locally unexemplified but never globally so, because this would mean not all concepts are based in correspondence. In this, Plato invented the Principle of Plenitude. Modalities can express temporary divergences between conception and reality, but only insofar as all modal terms are reducible—in the last instance—to eventual existents, and thus remain expressive of global identity between our frame and wider reality. (This being why, for Plato, reality *just is* the domain of the expression of the Idea [Grant, 2006].) Plato opens scope for becoming—and, concordantly, for temporary divergences between frame and object—with his mediating theory of forms, but only by reducing all of becoming’s “absent things”, in the last instance, to concrete existents and, thus, eventual one-to-one correspondences. (Plenitude allows local divergence between concept and reality

only inasmuch as it vouchsafes their wider bijection.) That is, as Rohr [1981] persuasively demonstrates, there is no such thing as *an eternally empty form* in Plato, or, no such thing as ‘a genuine unrealised possible’. Not yet explicit modal doctrine, plenitude is nonetheless evocatively distilled within the *Timaeus*’s account [Plato, 2008; 18] of the Demiurge’s magnanimity regarding existences and types: *all possibles must exist* [Lovejoy, 1936; 49-51]. And so, all modal talk is reduced, via intercession of time, to nonmodal tangibles; because, each and every concept, if it is a concept at all, eventually corresponds with being; and so, because all modals must exhaustively refer, none can grasp genuine failures of reference, such that, *a fortiori*, reference to the termination of human discursivity is foreclosed. Plato is consequently able to allow contingency whilst remaining within his forebear’s architecture of correspondence: thus, contingency is an object-level phenomenon, but never a framework-level one. Instantiations of concepts come and go, but there can never be an end to conception as such. This is because ‘to be’ is ‘to be intelligible’ precisely because all intelligibles will eventually be, without deficit or debit. Capaciousness for object-level contingency is purchased only on the proviso of full concept-level solvency between thinking and being. Plenitude, therefore, is simply Identity laced with temporality (enlisting time as mere lag upon total bijective affinity) consequently enforcing total equilibrium and homeostasis between reason and reality (because reality *is* rational). Nonetheless, Plato had thereby opened the way for the first explicit commencement of modal logic, limning the way for its future maturation beyond such early cul-de-sacs as construing modals solely as vehicles for fact-stating correspondences.

3.3—aristotle, c.350 BC

The inclination to explain away modalities in nonmodal terms—initiated by Plato’s plenistic armistice between mutability and monism—is perpetuated by Aristotle [Hintikka, 1981b; 71-2], the first self-conscious student of modal logic [Niiniluoto, 1988; 91]. Though already central issues within Plato’s *Timaeus* and similar works, Aristotle was the first to properly distinguish ‘necessity’, ‘possibility’, ‘contingency’, and ‘impossibility’, through attempting to explicate their unique expressive roles. The resulting modal logic was conspicuously *extensionalist*. What does this mean? Put simply, ‘extensional’ indexes a definition that functions by enumerating all extant instantings of the target term, defining its content solely via these actual instantiations. This is in contrast with ‘intensional’ definitions, which elucidate terms by elaborating necessary and sufficient conditions of their tenability, thus articulating the contents of their target term by mapping out a subjunctive space of its possible and appropriate application. Intensional explications, however, were importantly absent throughout the ancient world [Knuutilla, 1993; vii] insofar as they require appreciation of the role of counterfactuals in reasoning: an appreciation which—occluded by the strict correspondence theories of ancient thinkers—appears only much later. Following this, then, Aristotle is left to yield the meaning of modal notions by transposing them into the frequency of their instancing within time (i.e. by enumerating their extension, or distribution, of temporal instantiation). Concordantly, this produces the following schema: ‘impossible’ is what is never the case; ‘contingent’ is what is sometimes the case; ‘necessary’ is what is always the case [Knuutilla, 1993; 1-18]. This famously bestows what Hintikka [1973] dubbed the *statistical model of modality* (also known as the ‘temporal-frequency interpretation’). And insofar as it therefore translates modal notions entirely through their

reduction to nonmodal ones—measuring them only by their tangible realisation in time—this schema arrives as an explication of assumptions already implicit in Plato: in other words, Aristotle simply gave plenitude logical formalisation. What is directly relevant to our interests is that this logical rigorization illumines various ancillary presuppositions and entailments of such correspondence-based models, further clarifying their role in preventing conception upon the contingency of conception itself; indeed, the ‘notion of statistical modality traverses the whole history of Western philosophy’ [Borghini, 2016; 27] and is the prime culprit in occluding the metacognitive conditions under which alone empirical-level prospection of human extinction as causal event becomes theoretically tenable and specifiable.

For one, extensionalism duly limits us to a solely *diachronic* understanding of possibility (foreclosing understanding of ‘possibility’ as reference across *synchronic alternatives*) [Hintikka, 1973; 107-10]: i.e. ‘the possibility that any given event might not occur cannot coincide with its happening but is ascribed to some other time’ [Gelber, 2004; 125].⁴ This effectively limits total reality to given experience insofar as possibility can only express rearrangements within one established class, never distinctions across competing classes, such that we are denied the expressive resources to disagree with our received (i.e. experiential) picture of reality. Possibility, because it can only reference permutations within one ‘world’ rather than divergences across multiple ones, is not able to articulate the possibility that our given world-picture is itself incorrect: it can only express trivial alterations *within* the received model, never enable judgements between competing ones. One, therefore, cannot

⁴ Essentially, to say, whilst Socrates is sitting, that ‘it is possible that Socrates stands’ cannot be understood to be referring to the present moment but *must* refer to its definite future actualization.

refer outside the world of experience, such that one cannot gain traction upon the fact that experience might not exhaust the world. In pragmatic terms, this results in an absolutisation of human access such that we utterly cannot accredit claims regarding the precarity—and thus foreclosure—of such access *simpliciter*.

A second (and interconnected) ‘ancillary presupposition’ concerns extensionalism’s restriction of all truths concerning the world to logical truths. That is, because of its baked-in adherence to plenitude, the only items that are ‘never actual’ for extensionalism can be so solely for reasons of ultimately logical derivation: i.e. they can only not be for reasons of logical incoherence or contradiction, because if not, they would necessarily be eventually realised. Conversely, this means that *all* worldly truths must, at base, be apodictic in nature; that is, ‘true’ for ultimately conceptual reasons of demonstrable analysis rather than reasons of natural facticity [Hintikka, 1973; 71]. (As Hintikka lucidly explains [1981c], this is why the modern scientific notion of a ‘natural law’ was barred to the ancient world: as it denotes a parameter that could well have been determined otherwise but simply wasn’t.) This assumption has far-reaching consequences relevant to the historical development of humanity’s elaboration of both empirical- and concept-level contingency (it also congruently explains why Peripatetic ‘science’ is ‘conceptual-demonstrative’ and cannot be ‘empirical-inductive’ insofar as it makes all truths deducible). Most immediately, it makes statements regarding irreversibly extinct species tantamount to invocations of chimeras or goatstags. Second, it means all reality is, in the last analysis, entirely compliant with its demonstrative and syllogistic elaboration. In other words, reality has an inherently propositional structure. Underlying Aristotle’s model of demonstrative knowledge (“*apodeixis*”), this engenders the presumption that existence is

itself exhaustively rational in structure (i.e. sharing with knowledge the same categorial and propositional architectures) such that, by corollary, rationality simply cannot cease to exist. Reality, that is, is allowed no autonomy from our ultimately semantic determinations of it (an autonomy that reaches its later expressive apotheosis, of course, in articulation of ‘human extinction’) and this is largely because, as we have been exploring, modal terms—when limited entirely to extension and thus correspondence—simply cannot express the fact that our semantic and judicial resources are neither inherent nor native to reality as such (such that an existential foreclosure of sapience is incoherent). This is exemplified most cogently in the Stagirite’s doctrine of hylomorphism, which bluntly denies existence to matter beyond its categorial determinations, such that reality *just is* our taxonomic predications upon it. Indeed, by identifying ‘never actual’ with ‘logical incoherence’ by way of plenitude, Aristotelian extensionalism further has the damaging effect of demoting everything we do not *actually experience* to sharing joint-status with contradiction and logical incoherence (hence, why counterfactuals—as consistent yet inexistent scenarios—did not yet represent legitimate tools in reasoning; insofar as talking ‘beyond’ tangible facts is indistinct from talk invoking contradictory premises; such that the ‘unexperienced’ collapses into ‘never actual’, ergo also ‘impossible’, because there are no means to semantically distinguish these categories). And so, this, ultimately, is why the ancients *could* ponder future contingent sea-battles (insofar as such events index already recorded experiences) but utterly *could not* forecast the future as containing events (i.e. threats) entirely unexampled and unexpected (and, *in extremis*, beyond all possible expectation), and this being because, convinced that all modal concepts (indeed, all concepts *überhaupt*) must be in the business of directly corresponding, they forewent the discursive tools under which alone we can

reflect upon the limitations of correspondence, and thus also upon the fact that reality is not itself indubitably semantic-judicial in structure. Blind to its own limitations, conception could not but think of itself as identical with reality and *vice versa*, and—expunging any capaciousness for indexing the utterly unexpected or extrajudicial—thus could not encounter the precarity of its own contents and, *a fortiori*, could never appraise propositions upon its future foreclosure. Catastrophe, as apprehension of reality’s lack of judicial structures, *had to be learned*.

3.4—realism of the idea

Burnyeat, in [1982], contended ancient idealism impossible, denying its existence on the grounds that no premodern philosopher denies material objects in the Berkeleyan-sceptical mould. Yet, whilst the kind of subjectivist and immaterialist species of ‘idealism’ (which Burnyeat speciously identifies *holus-bolus* with the genus ‘idealism’) indeed *was* only made possible post-Descartes, this simply does not entail the ancients were consequent ‘realists’ in any sturdy or identifiably modern sense. The ‘realism’ default to the ancients was a ‘realism of the idea’ [Dunham et al., 2011], wherein ideas *just are* the architecture of the cosmos. Plato and Aristotle—both rooting all knowledge solely in correspondence—adhere identically to this model and are thus, in this way, ‘chips off the Parmenidean block’, important progresses over their pre-Socratic forebear notwithstanding.⁵ (Knowledge is “identical with its object” [Aristotle, 2014; i.685].) Simply, just as one could not be a subjective idealist prior to a certain juncture, one could not be a robust or scientific realist either, and

⁵ ‘In the *Sophist* Plato espoused the Parmenidean view that all meaningful discourse (*logos*) must be about a being of some sort’ [Rescher, 2003; 114]; likewise, Aristotle ‘shared the general Platonist presupposition similar to the Parmenidean principle that what can be and what is intelligible are the same’ [Knuutilla, 1993; 35].

this is because both these distinctly modern master-ideas are consequent upon a localisation of concepts to concept-using *minds*.⁶ The Idea had to be de-reified. (This had to take place before robustly mind-independent existents could be posited, let alone be the subject of scepticism, as in scientific realism and Berkeleyan irrealism respectively.) And, significantly, the pragmatic condition for expressing conceptual parochialism—as well as that of expressing mind-independent existents—is capacity to (counterfactually) imagine a world stripped entirely of all epistemicity and intentional/cognitive content. Here, then, is the germinal seed of modernity’s sensitization to the precarity of *Homo sapiens* and its concept-mongering enterprise, and it finds its beginnings—within the very cradle of scientific revolution—in rejuvenations of modal philosophy and efflorescences of counterfactual reasoning within the late medieval world. Indeed, it will soon become apparent that sensitization to ‘extinction’ has been conceptually implicit, and complicit, in science’s explanatory apparatus since its dawn.

4—THE FIRST CATASTROPHISM: MEDIÉVAL DIASPORA

The aptitude to picture nature as possibly entirely otherwise than we conceive it to be is historically of a piece with the capacity to articulate that concepts aren’t themselves necessarily

⁶ We oppose ‘robust realism’ to ‘naïve realism’, the latter of which is pragmatically indistinct from ancient idealism’s ‘realism of the idea’ insofar as both allow no meaningful distinction between conceptual frame and objective content and, accordingly, ignore conceptual cognition’s insuperable finitude. And, insofar as one cannot think cognition finite, one cannot understand its prospective extinction. Whether ‘naïve realists’ or ‘realists of the idea’, then, it makes little difference for our purposes, insofar as all ancient philosophers fail this benchmark of any realism worthy of the name: the ability to coherently accommodate statements upon human extinction *qua* a world without concept-use.

natural and, by consequence, are neither essential nor inherent within nature. *The two are sides of a pragmatic coin.* In promoting the former, medieval philosophy accidentally gave voice to the latter. This is because imagining entirely counterfactual worlds involves emancipating modal expressions from strict reference to actual facts, such that, governed now by intensional consistency rather than extensional correspondence, conditionals and ‘what-if’ statements could begin being deployed to adjudicate the coherence of our concepts themselves—i.e. their ranges of appropriate use—and thus assume their full expressive role delineating the fallibility of our assertions *apropos* nature rather than endlessly reiterating tautological identity between nature and assertion. For talking about how the objective world could have been radically otherwise than we conceive it *always* entails metaconceptual commitments regarding the insecurity of our conceptual apparatus relative to the world, and this is so because propositions of the prior class involve admitting (however implicitly) the inessential nature of conceptual structures relative to existence. In representing manufactured and artificial worlds, we stumbled upon the manufactured and artefactual status of representation itself. The latter came as the unintended—yet inevitable and far-reaching—consequence of the former, the motivation of which itself came originally, of course, from theology.

As Alanen & Knuuttila [1988; 2] aver, a ‘new approach [to modality] emerged from the idea of an omnipotent God’. Representing an ‘alien intrusion’ [Milton, 1981; 187], that is, relative to pagan thought’s extensionalist reduction of natural truth to apodictic truth, voluntarism’s fundamental understanding of divine choice as (more or less) arbitrary selection between separate and alternative world-plans required new tools contravening the narrowly correspondence-based schemas of the ancients alongside their consequently unwavering faith in an amniotic *plenum formarum* and *nexus*

causarum (by way of their uninspected identification of ‘to be’ and ‘to be reasonable’).⁷ Indeed, Aristotle’s organon had measured possibilities solely through their actualisation, yet this proved incompatible with divinity’s free-power: surely, God could have created worlds diverging from the actual *but simply chose not to?* ‘Western theism’, by consequence, ‘considers the world contingently’—in totality, not just part [Wegter-McNelly, 2007]. Accept this, however, and existence can no longer inviolably be a product of apodictic or demonstrable necessitude: it cannot, *pace* Plato and Aristotle, be the exhaustive embodiment of rationality itself. This, therefore, meant disentangling the previously presumed identification of naked existence and rational contentfulness: ‘to be’ is not inherently ‘to be justifiable’. Hence, Blumenberg’s [1983] late medieval “*Ordnungsschwund*” (loss of a rational cosmos), which he identifies as igniting “*Neuzeit*”.

The first concrete example of this is found in the extreme voluntarism of tenth century Islamic Ash‘ariyah, wherein, in reproaching the Aristotle-inspired encroachments of preceding Mu‘tazilite philosophers (*‘falāsifa’*) and their leveraging of logical analysis above divine will, the Ash‘arite theologians wielded strong occasionalism in order to centrifuge the demonstrative connective tissue and efficient causations of the pagan rational cosmos into a conglomerate of utterly discrete, atomistic events—entirely logically disarticulated and thus contingent. One could not infer any item’s existence from any other [Peirce, 1955; 220]. Later, in Europe, Gilbert of Poitiers would describe natural laws as mere “custom of nature”, subject to no logical basis and entirely contingent [Nielsen, 1982; 136 & Knuuttila, 1991; 76].

⁷ Stoic and Epicurean cosmologies didn’t depart from plenitude [Rubenstein, 2014], thus remained comprehensively constrained to narrowly correspondence-based outlooks.

To exalt God’s freedom, voluntarists stripped the cosmos of inherent rationality. Although undoubtedly conducted in the name of piety, this had the long-term effect of unveiling reason’s precarity within the (now arational) cosmos. For, in order to dismantle and unpeel the ancient identification of existence and rationality (inasmuch as it impinged upon divinity’s freedom to select other plausible world-orders) voluntarists across both the Arabic and Christian medieval world inevitably developed the discursive tools by which to imagine a cosmos *sans* reason. That is, though voluntarism, of course, does not at all directly lead to endorsing the possibility of extinction at the level of assertion and objective committal (because, for one, all medieval theologians retained failsafe conviction in God’s goodness—not to mention their lack of requisite scientific-technical vocabularies) such doctrine nevertheless incubated the metacognitive tools (chiefly counterfactual locutions) under which alone ‘extinction’ would, much later, become objectively specifiable as a naturalistic event within empirical orders (consequent upon the required empirical-descriptive competences—from actuary to geoscience—falling into place).

4.1—the incoherence of correspondence, 1095

Ash‘arism reached an apex in al-Ghazālī’s *Tahāfut al-Falāsifah* of 1095 (translated as *Incoherence of the Philosophers*) wherein the Sunni theologian, presaging Hume [Riker, 1996], sought to denigrate efficient causation by arguing one cannot *demonstrate* the necessity of natural conjunctions and regularities. “[O]bservation”, al-Ghazālī writes, “proves only a simultaneity, not a causation” [1969; 316-7]. Importantly, as an unintended side effect of this project, al-Ghazālī pointed towards a powerful new way of using modal expressions: one that, based in consistency rather than correspondence, evinced a usage of modals to articulate lawlike limitations and constraints upon our

concepts *entirely independent* of the frequency (or lack thereof) of their exemplification within experience. Contingency had begun to become reflexive.

That is, raising first specter of philosophical catastrophism, al-Ghazālī buttressed his argument that causal conjunctions could not be logically demonstrated by conjuring unrealized yet logically plausible events that *could* disrupt the regular causal fabric upon divine decree. This required him breaking from the statistical modal logic of Arabic Peripatetics by projecting entirely unactualized and counterfactual states of affairs that nonetheless plausibly *could* interrupt regular causality (similar to Hume’s ‘conceivability argument’ [Morris, 1988; 65]). Crucially, ‘[n]o reference to actual existents is necessary’ for this argument: ‘only that the mind be capable of grasping a certain set of [mere possibles as mere possibles]’ [Kukkonen, 2006; 127]. This hints towards a rarefaction of modal terms from narrow correspondence, extracting them from plenitude’s strictly ontologizing foundations, and upgrading them toward instead articulating the coherences and compatibilities of our own concepts—i.e. their intensional contents—over and above merely their extensional realization within concrete experiences. Crucially, this is because al-Ghazālī uses merely possible cases (even if never real) to *limit* reason’s reach (i.e. nature *could* become irregular, and we cannot demonstrate this as impossible in advance, ergo reason is humbled). His propositions that nature could be objectively otherwise pan out, therefore, as metaconceptual invigilations upon the fallibility of reasoning itself relative to nature (namely, giving the lie to the assumption that everything under the sun can be accounted for by demonstrative analyses). Modals now could begin to express the coherence and limitations of concepts across counterfactual and subjunctive ranges rather than merely enunciating the latency or frequency of their instantiation within concrete experience: by corollary, this meant the

pathway was opening up for propositions upon existents subsisting beyond *any* human experiencings (whether potential or concrete) which arrived as the capacity to postulate possible worlds *absented* of discursive intellect *tout court*. First, however, the idea of a ‘possible world’ needed to be developed.

4.2—medieval tychism, 1277

The notion had progressed apace since Augustine’s much earlier voluntaristic doctrine of creation (“*Potuit sed noluit*” [1892; xxix.4]), and yet, rigorous understanding of intensional possibilities (implicit within al-Ghazālī’s allusion to God selecting between competing counterfactual options) only reached full explication with Duns Scotus during the so-called twelfth century renaissance. This is important because an intensional model of possibility is requisite to postulating *possibilia* utterly divorced from actual experience (insofar as intension defines terms by their conceptual coherence across merely possible cases as opposed to instantiations within actual experience), and thus it lies at the very heart of any conception of ‘mind-independence’ (reliant as this is upon meaningful distinctions between horizons of expectation and spaces of experience). Intensional understandings of modality are the very seedbed of finitude; thus also of any sense of a reality beyond—or, indeed, *after*—conception.

Modal argumentation, that is, had been introduced to the medieval West via Boëthius’ translation of *De interpretatione*, yet it took ‘almost half a millennium’ [Holopainen, 2006; 103] before gaining pace around the eleventh century (after which early scholasticism subsequently also encountered Arabic atomism via Maimonides’ critiques) and doing so via recapitulation of Augustine’s earlier insinuation of divinity’s ‘executive power’ discriminating between ‘alternative providential designs’ [Alanen & Knuuttila, 1988] (i.e. synchronic possibilities, or, the ‘medieval version of possible worlds’

[Goddu, 1984; 218]). From Anselm through Abelard, from Peter Damian to Gilbert of Poitiers, such notions gained traction throughout Europe's twelfth century renaissance. This philosophical background was concretized in the newly minted theological distinction between *potentia dei absoluta et ordinata*, an important bifurcation baptized by Alexander of Hales (though finding earlier sources in thinkers like Origen) [Funkenstein, 1986; 126]. This, in step with 'gradual disenchantment of late medieval thinkers with [plenitude]' [Hintikka & Kannisto, 1981d; 287], encouraged synchronic conceptions of possibility (referring to distinctions *across* worlds rather than rearrangements *within* one, given world) opening up the scholastic imagination to worlds and histories radically diverging from the received Peripatetic one. This explains invigoration of thought-experimenting during the period [Grellard, 2011; 65], alongside Funkenstein's image of 'schoolmen [driven] by an almost obsessive compulsion [to] devise orders of nature [different] from the one admittedly existing' [1986; 122].⁸ Nonetheless, despite being ensconced in orthodoxy by the Condemnations of 1277, these merely 'possible worlds' would not be rigorously outlined with precision until Duns Scotus's systematization and consolidation:

I do not call something contingent because it is not always or necessarily the case,
but because the opposite of it could be actual at the very moment it occurs.
[Scotus, 1987; 55]

Scotus here made explicit what was implicit in prior thinkers from al-Ghazālī to Peter Damian, finally consummating the medieval separation of temporality and modality. This is a fully intensional transposition of modal terminology, understanding modals as 'formally independent of any real

⁸ We recall Playfair's diagnosis of a similar "compulsion" in eighteenth century geotherists: here was an earlier 'Cambrian Explosion' of miniature world-models and artificial-cosmoi in natural philosophy, at another important juncture concerning reflection on contingency.

potency, passive or active’ [Lecq, 1998; 93]—thus entirely divorced from merely actual experiences and diachronic realisation—through instead making such terms explicit as delineating a space of conceptual consistency carved up by rational relations of compatibility or compossibility, rather than barricaded and gerrymandered by the fickle horizons of actual human experience.⁹

In other words, only here are possibilities divorced from *any* uniformity with phenomenal actuality first made fully cognitively coherent within discourse. The Subtle Doctor (unaware of its long-durational ramifications) *had emancipated the logical space of possibility, thus also of conception, from the strictures of human history and prior experience*. In other words, here is the logical seedbed, and upstream source, of modernity’s empowering love affair with simulation (just waiting for its seventeenth century delegation to calculus, its twentieth century automatization by computation, and its latter-day institutionalization as planetary prediction). Yet, insofar as Scotus did not use his new-found notions to reflect upon the limitations of concept-use within reality, his unexperienced *possibilia* could not gain practical urgency as nature’s ability to catastrophically contravene our expectations. This implication was left for Scotus’s successor, William of Ockham, the first to explicitly deploy the new-developed modal technology to imagine a world stripped of human thought: thusly invigorating science’s attempts to explain myriad existents not just beyond actual experience but beyond *all possible experience*.

⁹ This understanding, for example, is *utterly essential* for Cardano’s 1550s abstraction of the “circuit” of the die.

4.3—realism-as-immolation, 1300s

Ockham deployed the new intensional modalities to self-represent the contingency of representations, providing the first articulation of true mind-independence by way of counterfactually imagining a world without thought, thus consummating the “*Ordnungsschwund*”. By first expressing that our propositional and conceptual capture of the world is not itself part of or identical to the independent world, this is the germ of later ratiocinations upon human terminus as the foreclosure of our concept-mongering enterprise (and, further, it is likewise germ of modernity ‘at large’, in that it lies upstream of the endlessly disruptive and productive idea that worldly affairs can be radically otherwise: serially unleashing the troika forces of scientific curiosity, philosophical critique, and political reform across subsequent centuries).

Ockham, that is, intensified earlier occasionalism by using the new modal philosophy to subtract the world of *all* propositional content. Motivated by conviction that our mental categories (universals, abstractions, categories, etc.) could not be a limit on what God can do, the Venerable Inceptor completely voided existence of inherent epistemic contentfulness (by way of retracting categorial terms entirely to linguistic performances or ‘mental language’). Though already insinuated by prior occasionalists from Ash‘arism onward, Ockham could consummate this expatriation of rationality by consistently employing new counterfactual locutions to put it into *full relief*.

For Ockhamite nominalism, only singulars truly exist (because categorial structures—such as “species”—cannot be impingements upon God’s free will). As Nicholas of Autrecourt [1994; 169] proclaimed, one *utterly cannot* infer any one thing’s existence from the existence of another thing. To buttress this commitment, Ockham deployed a counterfactual benchmarking test. As ‘criterion of

objecthood' all singulars are true singulars *if and only if* a possible world can be modelled within which *only* said object exists *and nothing else*. (Everything else could be victim to the eponymous razor.) Within the counterfactual crucible of this thought experiment—premised as it is upon the new legitimacy for subjunctive reasoning beyond correspondence—naked existence and epistemic content are comprehensively disentangled. And, though the Franciscan voluntarist advocated this to fortify and edify God's unmitigated power (i.e. power to create singulars beyond the strictures of thought's predicative architecture), this radically new conception of a 'thoroughly individualized thing' [Funkenstein, 1986; 135-40] had the knock-on effect of ascribing 'to matter a fully actualized status apart from and prior to form, natures, or relations, which have [thereby] been deprived of ontological status' [Hanby, 2011; 353]. Accordingly, it was the first coherent articulation of a hypothetical object existing *without any* minds and, more so, *beyond any* feasible mental intentionality and intentional content (i.e. 'form', 'category', etc.). It was, in other words, the first theoretical entity—the primal-scene of scientific realism.

Indeed, many have postulated Ockhamism as the cradle of seventeenth century science (Duhem [1906-13; ii.412] even dubbed the 1277 Condemnations the 'date of birth of modern science'). The voluntarist 'compulsion' to imagine worlds entirely otherwise than the apparent one is propaedeutic to the scientist's discovery that the actual world in fact *is* otherwise than it intuitively appears and thus, furthermore, is the gateway to sensitization to the contingency of appearance as such.¹⁰ Modern science is a fortuitous 'exaptation' of this former efflorescence. Certainly, science's early

¹⁰ Scholastic contrivance of artefactual world-models beyond appearances being germinal prologue to the model-based reasoning integral to later scientific revolutions: especially, indeed, eighteenth century geology's postulation of alien planets long before—and after—*Homo sapiens*.

breakthroughs are serially traceable to this nominalist root. For one, imagining objects, hypothetically, outside of intentional relations, as Ockham did, lies at root of the early modern distinction between primary and secondary qualities. Funkenstein, moreover, notes Galileo's employment of entirely counterfactual scenarios, analogous to Ockham's own, in order to arrive at unobservable and/or physically impossible limit cases required to formulate counter-intuitive breakthroughs like the law of inertia [1989; 152-79]. Oakley and Milton [1981], additionally, both stress the indispensability of nominalism and voluntarism to the seventeenth century triumph of physical laws and nomic formulae: noting many figureheads of scientific revolution, from Descartes to Newton to Boyle, as alike voluntarists in theological matters. Indeed, natural laws *are* laws precisely because they are *subjunctively robust*, meaning they cover counterfactual or merely hypothetical instances, thusly requiring intensional articulation for their expression.¹¹ Their study and definition, moreover, constitutively requires appreciation that such laws *could have been otherwise* (as Grosseteste's early world-model attests) or, in other words, are nomologically contingent (premised upon merely natural necessity) in a way that Aristotelian demonstrative science (and its adherence to plenitude) could not comprehend by way of its confinement of truths to analytic or apodictic truths (as previously explored).

Concatenating all of this is one fundamental thread: *all of these developments demand reasoning from counterfactuals* (i.e. reference to subjunctive cases beyond experiential enumeration) *and, further, this type of reasoning arrives as self-reflections upon thought's own insuperable contingency, emerging by way of hypothetically imagining a world beyond or without thought.* Galileo is exemplary

¹¹ 'Subjunctive robustness' is borrowed from Brandom [2014; 42-3].

regarding this entwinement of scientific realism and the subjunctive erasure of thought: “I think that tastes, odours, colours, and so on are no more than mere names so far as the object [is] concerned [...] Hence, if the living creature were removed, all these qualities would be wiped away and annihilated” [1957; 274]. We note hereby that thought’s subjunctive self-annihilation—homologous with immolating anticipation of its prospective terminus in time—always lay at the entrance of modern science. Science’s lawlike statements and mind-independent objects are understandable as laws and as mind-independents precisely because they index structures, fallible though their formulation may be, that *hold without observers*: they must implicitly be, in a special way, *extinction-proof*. This is what Galileo indicates, highlighting that such postulates are reached via performative (counterfactual) self-annihilation, and thus insinuating this as a *benchmark test* for objectivity.¹² This should give us pause, as it alerts us to its Ockhamite pedigree; indeed, Galileo’s selection of the term “*annihilate*” explicitly harkens back to the Venerable Inceptor.

Galileo’s wording is notable, that is, because Ockham named his thought-experimenting procedure (used to accredit objecthood to his ‘thoroughly individualized things’) the “Principle of Annihilation” [Funkenstein, 1986; 135]. The protocol was as follows: the status of every particular reality must be tested against its being considered “*toto mundo destructo*” [Ockham, 1957; 26], or, against the total liquidation and elimination of our present world along with its all its informing contexts and relations (intentional ones included, of course). In this procedure of *annihilatio mundi*

¹² Again, the ‘benchmark’ of any realism worthy of the name is its ability to incorporate statements involving human extinction. Science’s norm of objectivity requires antecedent modal (counterfactually involved) commitments, one of which is that objective descriptors would hold *should no human exist*. Hence, why extinction is implicit in scientific realism from the beginning.

we find the implicit conditions and thus conceptual ancestry of all later explicit statements upon ‘extinction’ *qua* ultimate articulation of mind-independence: and this is so not because of any apocalyptic pyrotechny in the Principle’s counterfactual demolition of worldly plenty, but, rather, because of its subtractive abrasion of reality to its mind-independent kernel. This entirely eliminative technique—performatively stripping existence of any mental content—allowed Ockham to propose, for the first time, a possible world entirely without mindedness, coherently expressing a total non-existence of thought and epistemicity therein and doing so without jeopardizing the fabric of existence itself insofar as it must do so for any consistent correspondence theorist or ‘realist of the idea’. Indeed, we here pause to clarify that, within the pre-modern attitude that cannot properly disentangle knowledge and existence, to postulate a world without reasons is to postulate no world at all, insofar as existence *just is* its propositional capture (this, indeed, being what had made mind-independence—and extinction—cognitively unavailable since philosophy’s beginnings).¹³ This is why for Aquinas there is no possible world without mind: the supposition of a world with existent things but no cognizing minds—not even the God’s—is an “impossible supposition” [1952; i.11]. Given the clarifications accomplished by such counterfactual reasoning, however, the prospect of a world-without-reasons had become unignorable.

Aquinas presents us with the perfect example of this, where he prevaricates upon God’s ability to annihilate species. Saint Thomas, that is, had claimed that, *per potentia absoluta*, divinity could eliminate creatures should he wish, whilst later equivocated that, in fact, God could not do this,

¹³ This being the basis, again, of Aquinas’s remark that “[e]ven if there were no human intellects, things could [still] be said to be true because of their relation to the divine intellect” [1952; i.11]. Indeed, he implies that there is *no possible world without mind*.

because doing so would breach natural law and endanger reality's mutually cohering indexical structure or "*ordo ad invicem*" [Aquinas, 1974; Q.104]. From the pre-modern perspective that refuses to distinguish reason from existence, a nature that is not rational (i.e. propositionally sorted and indexed) is exactly nothing at all; or, since 'to be is to be rational', should reality admit of any unreason, it is concordantly nihility to the very extent that it is. Again, object-level contingency redoubles as higher-order, metaphysical threat for the philosopher who identifies thinking with being: creaturely species could be irreversibly terminated *only if* reality is admitted as thoroughgoingly irrational—because a real absence, one that 'just is' unexplainably and without reconciliation, redoubles as a real absence of reasons—and yet, for the consistent correspondence theorist, since reality *just is* its rational structuration, to admit irrationality into existence is to nullify existence itself. "Wherefore we must conclude by denying absolutely that anything at all will be annihilated", Thomas ordained [Q.104, a.4]. Indeed, it was sometimes held that if God *should* annihilate any species, thus admitting irrationality into reality, it would instigate a nullifying chain-reaction, triggering a 'meontic cascade' that would consume utterly everything—from particulars up to universals—eventually destroying both God and the cosmos in a runaway process of erasure [Wyclif, 1985a; 307-14 & Lahey, 2009; 121-2].¹⁴ For the correspondence theorist, the territory is nothing but its map, such that rationality and existence hold a mutually-reinforcing 'suicide pact':

¹⁴ Wyclif (staunch realist concerning universals) exemplified this, by arguing that the outright elimination of any item would entail the elimination of everything essential to it, including all the universals that inform it, triggering an autocatalytic destruction of each universal that indexes the item, cascading upward from species to genus, all the way until the very 'index' itself must be entirely erased: for, since 'being' is itself an indexing universal, it too must go. For the correspondence theorist, the 'territory is nothing but its map', such that vandalizing one vandalizes the other.

eliminate the one, eliminate the other. Accordingly, Aquinas had to hold that intellectual content persists across all possible worlds: there is no possible world at which there is no inherent rational contentfulness; thus, whilst human intellects may be imagined not to subsist at a possible world, reason-as-such is necessary across them all; Aquinas confesses this and acknowledges that, for him, to imagine such a world is to tarry with impossibility [1952; i.11]. This is all downstream of the fundamental Thomist faith in “*adequatio rei ad intellectum*”, or, the conviction that reality just is its propositional framework (a medieval ‘mythical given’, therefore). From within this framework, any autonomy of existence from reasoning, and *vice versa*, could not but be considered mutually assured destruction for both.

Ockham’s nominalism refused this, but only through simultaneously admitting the possibility of a world absented of all thought. His innovative technique of *annihilatio mundi* cut through the prior mutually-enforcing pact, paring existence to its mind-independent core. The Inceptor, that is, could only reach the pragmatic self-limitations of nominalism (relegating truth-values to sentences, classifying *summa genera* as linguistic categories, whilst parochializing propositional contents to ‘mental language’) by disarticulating the *adequatio* previously presumed between reason and existence and, in turn, he could only do this by deploying the new counterfactual techniques of his forebears to assert the objective plausibility of a world without mind. In so doing, where his opponents had reified semantic structure as widest reality such that the termination of semantics was simultaneously the termination of reality itself, Ockhamite nominalism, by disentangling the two, could coherently model a possible world stripped of all mindedness and do so without triggering some

metaphysically-inflated meontic cascade of mutually assured destruction. Put differently, mind-independence had been announced.

4.4—*felix culpa*

Ockham's route to his mind-independent object was through counterfactually imagining rational contents and concerns destroyed and extinguished. Articulating a reality beyond minds requires mentality's subjunctive extinction, even if only implicitly. ('Extinction', again, denotes self-reflection before it demands mitigation—at least in terms of intellectual history.) Therefore, sensitization to such an eventuality—slowly unfurling, across modernity, into robust anticipation of future X-risks—always lay, implicit, at the nominalist entrance to modern science: for, whilst such catastrophic self-awareness instigates modernity's acute sense of the disastrous and unexpected by limning a path beyond the umbilical foundationalism of the ancients, it *simultaneously* installs our drive to strategically update our theories and strategize in the fact of uncertainty. *Felix culpa*. By excoriating existence of all inherent conceptual content, Ockham's eliminative technique first allowed capaciousness for existents *comprehensively falling beyond* (current) conceptual categorisation and capture, and consequently lubricated cognitive sensitivity to nature's autonomy from cognitive jurisdiction (its extrajudiciality—both theoretical and normative—manifested as autonomy from rational norms and attendant “waste fertility”) in the form of *responsivity to nature's non-responsivity to semantic capture*: or, new openness to the unexpected, inexplicable and anomalous. (Ancient philosophy, allowing no autonomy of nature from intelligibility, simply cannot be cognizant of the unexpected *as* unexpected in this precise sense.) Allowing capaciousness for real—yet unknown—objects, this new ontology first facilitated our epistemic receptivity to hypothesized and unrealised

events *entirely beyond* current experience or historical expectation. In this, the ‘first’ catastrophe was cognitive rather than objective, doxastic rather than aleatory, and self-inflicted before befallen. ‘Catastrophe’ was learnt, never given. Or, because observation is theory-laden, disasters were not capable of being *observed* as such before this development. Historically, this fits with a new tendency, during later middle ages, to apprehend disaster—such as the ruinous 1348 earthquake in plague-stricken Alpine Europe—as product of an extrajudicial, autonomous, and unpredictable nature rather than the normatively motivated sentencing of divine judiciary [Rohr, 2003 & Merchant, 2016; 57]. Nonetheless, only through this new sense of catastrophe, attendant as it is upon sensitization to finitude, does science’s self-correcting project get underway: only by self-representing the gap between representation and reality, and tracking this in the form of receptivity to the unexpected, are we motivated to update our theories and infirm old ones. Thus, though sensitization to ‘extinction’ always lay implicit in the foundations of science, it also instates the rational norm—later titled ‘*objectivity*’—that vitalizes inquiry. A fortunate fall, then.

5—THE GLOBALIZATION OF CRITIQUE: AUFKLÄRUNG

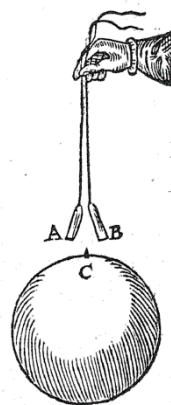
5.1—finitude’s enunciation

In nominalism lay the localization of concepts to concept-mongering animals, emerging from reflexive application of newly-ramified modal understandings concerning contingency. An understanding entirely eluding the ancients, said parochialization, once having been announced, reverberated forthwith throughout the fundament of early modern thought. Having enthusiastically cognized artificial worlds in pursuit of edifying omnipotent divinity, schoolmen had inadvertently

exposed that cognition was in fact *itself* interminably artefactual; this being because imagining the world in any way otherwise than appearance is indistinguishable from sensitizing oneself to the contingency—thus artifice—of appearances themselves. Human cognition was revealed as corrigible model rather than perfect microcosm; and models are precarious rather than perspicacious; liable to “tremble, gleam, and disappear” like a “bubble burst”. This is the source of modernity’s founding scepticism. For a reality not conceptual in structure cannot be guaranteed to be adequate with conceptual strictures, thereby becoming, in fundamental ways, epistemologically unreliable: whether at the hands of a deceiving god or at the whim of our limited faculties of sense-perception. The new counterfactual conceptions developed by medieval scholars, indeed, inform both Cartesian radical doubt as well as Hume’s causal scepticism—both occasioned by way of postulating threatening subjunctive scenarios wherein the world *could* be radically otherwise.¹⁵ It was on the basis of this (counterfactually-informed) unreliability that Descartes saw fit to retract the archetypal and causative “Idea” of Platonic cosmological production, retreating it to human psychological interiority. Ideas, post-Descartes, primarily ‘refer to the contents of the human mind’ [Dunham et al., 2011; 45] rather than cosmic *summa genera*, and, as such, they are set to work procedurally producing an inner world—as pumps in the pipeline of phenomenal appearance—rather than any emanative, external cosmos. The mind, indeed, was the original crucible. This move, of mindedness from *speculum* to *simulation*, is mirrored in Descartes’ thought-experimenting and worldmaking methodology [Ramachandran, 2015]: his procedure of manufacturing self-consciously contrived cosmoi in

¹⁵ Counterfactuals are heavily implicated in ‘Hume’s Dictum’ and his ‘Argument from Conceivability’.

“*espaces imaginaires*”, rivalling William Gilbert’s near-contemporaneous experimental terrellas. And, though this stress on the artefactual nature of natural knowledge triggered a move from analysis to experiment—and from demonstration to simulation—that ignited the scientific method, it cast philosophy into profound crisis. Indeed, the *artificial* basis of *naturalistic* knowledge has long been the success of science and the scandal of philosophy: for reason seems to grasp nature better by progressively alienating itself from any eidetic or auratic foundation within it; indeed, the very success of seventeenth century scientific languages, like calculus, lies in their functionalization of their own artificiality in order to divest natural intuition of its prejudices [Krämer, 2003]; ultimately, approaching the ‘view from nowhere’ demands mitigating for one’s own regional perspective by way of self-inspecting its own corrigibility, which is why respecting hard objectivity inherently implies cognition upon our own extinction; yet early modern philosophy, clamouring to resupply new foundations for thought within being, could not yet sanction this expatriating dynamic and neither, thereby, could it yet explicate the implicit content therein regarding the cosmic contingency of our



Gilbert's model worlds [1600; 133]

human purview.

5.2—annihilating doubt, 1641

For Descartes, an untrustworthy world demanded thought be disengaged from it, retreating inward towards a new psychological foundation—one premised upon the apparent inviolability of ‘the apparent’—in order to redoubt itself and its claims. Yet, as we shall see, this disengagement did not disentangle existences and justifications, or being and thinking, but instead entangled them once again, merely on a subjectivist basis.

This divorce triggered Cartesian radical doubting, which, though indeed occasioned by the nominalist spectre of a capricious deity—or, *deus deceptor*—surreptitiously also came to resemble the very potency it was seeking asylum from. For doubt’s ability to put everything in jeopardy was articulated, that is, primarily as a transposition of contingency’s corrosive ability to annihilate objects: thusly unveiling omnipotence as the conceptual blueprint of Cartesian doubt. This is largely because Descartes had no clear conception of the distinction between *de dicto* and *de re* modalities (i.e. ‘contingence’ as withholding endorsement for a claim and pointing out its dubitability *versus* ‘contingence’ as flagging real and concrete modes of existence or non-existence of an object). Given this, there is no clean discrimination in Descartes between doxastic doubting and ontic annihilation such that, in practice, he presumes them commensurate in range and scope. Thus, by exact converse of doubt’s annihilation of objects of cognition (*toto mundo destructo*), the inability to doubt is taken to secure for an item necessary and inalienable ontic existence. Thus, seizing upon the seeming incorrigibility of ‘seeming’, the fact *doubt cannot doubt itself* operates for Descartes as establishing the doubting mind’s existential irrefragability and existential foundation. So, where Descartes’ radical doubt eliminates everything else, it cannot doubt the being of the self, insofar as, by this very token,

thought becomes thereby a necessary part of being. Through this, Descartes re-established a substantive isthmus between thinking and being, a new foundation in the face of radical contingency, yet one that, in so doing, simply cannot endorse claims upon the contingency of thought itself. The family-resemblance of this to the Ontological Argument is not accidental, its linkage to Cartesian convictions that innate ideas are “imprint[ed]” upon our minds is clear [1985; iii.23 & i.131], and its tendency to derive real existents from mere propositional contexts betrays the recidivism of Parmenidean impulses: thus, where Cartesian meditation flirts with the hypothetical elimination of all “minds” in its nihilating vision [1985; ii.16], it instantly recoils from this because it re-mortgages the inviolable identity of justification and existence, or, thought and being.

5.3—theodicy’s inversion, 1710

During the 1680s, Leibniz inherited the problem of radical contingency (namely, its disassociation of conceptual content from brute existence and thus normativity from ontology) and responded by inventing the philosopheme of ‘possible worlds’, thus reducing contingency from denoting a true and ineliminable unreason *within* the fabric of the world (for an irrational world could admit, indeed, of the death of reason: a prime injustice) to instead expressing myriad relations *between* alternative ‘worlds’ as *relata* (contingency doesn’t express something autochthonous to the world—since our world is perfect and thus perfectly accounted for—but expresses indexical relations between our world and other, merely possible ones).¹⁶ This, therefore, allowed Leibniz leeway to keep God’s *interworldly* free choice whilst also deftly retaining plenitude as *intra*worldly factum: in our maximally reasonable world, there is nothing entirely inexplicable, nothing fundamentally

¹⁶ This, clearly, is heir to Scotus’s synchronic and intensional theory of modality.

rebarbative to reason, but we can coherently refer to how ‘things could have been otherwise’ than is maximally reasonable nonetheless. (A neat way of expressing this is noting that ‘plenitude holds for compossibility’ but not for possibility *simpliciter* [Hintikka, 1981c; 269-70].) Having volunteered this intuitively appealing modal theory, the unreason of contingency exists only *between* worlds, whereas within our *own* world—which is, on faith, the best—there is only interminable reasonableness and inviolable justice. And so, Leibniz domesticated contingency by explicating it as a mere relation *between* worlds, rather than a genuine inscrutability *within* the world: one that would thereby invalidate the necessary rationality of our world such that reason could (contingently) senesce within it. (This schema was buttressed by the polymath’s decree of “pre-established harmony”: like Cartesian innate ideas and Thomist *adequatio* this represents another mythical given mingling meaningfulness and existence such that meaning cannot cease to exist.)

And yet, by resting his foundation and guarantee of plenitude entirely upon conviction in God’s goodness, Leibniz was, of course, resting the entire theodical edifice upon a support soon shattered in the 1755 ruins of Lisbon: a violent manifestation of extrajudiciality if there ever was one (striking on All Saints’ Day, many victims were attending mass when the roofs collapsed). For, in the absence of a benevolent God to vouchsafe plenitude and perfection, the merely synchronic distinctions of drastic saltation between variant, yet untouched, ‘worlds’ are free to collapse violently back into the one fully actual timeline in the form of irreducible contingences by way of gigantic, world-changing cataclysms: this being exactly what geological catastrophism would soon propose as scientific fact. Catastrophism, that is, crashes Leibniz’s merely possible worlds back down into the body of our singular planet, bringing them ‘down to earth’ and concretizing their synchronic divergences as actual revolutions

throughout unpredictable time. Thus, contingency became reality rather than relation, with ‘worlds’ becoming temporal intervals rather than untouching *relata*. Leibniz’s innovative modal schema, that is, had infinitely deepened contingency’s reservoir, yet he had dammed this up with a flimsy theodicy: geoscientific understanding, in undermining the latter, simultaneously unleashed the former. And so, rather than denoting irreducible discontinuities safely quarantined as merely synchronic relations, catastrophism ‘breaks the dam’ on contingency, unleashing it instead as ruptures resonant throughout sovereign time. A time, that is, no longer pinioned by plenitude nor neatly refracted into parallel bundles of compossibles but containing unpredictability inconsolably; a time evinced, in other words, by the “terrible events” Cuvier proposed punctuating geohistory [2008; 190], alongside his signposting ours as merely the “*creation actuelle*”; a time inscribed, moreover, within the graveyard of failed and future worlds jumbled throughout the mantle in Byron’s *Cain*, becoming thereby legible as the pyramid of possible worlds represented in Leibniz’s *Théodicée*, but inverted and subducted underground as traces of true catastrophe. In this, unrealized *possibilia*—concretized as geohistorical intervals rather than synchronic alternatives—are transformed from argumentatively buttressing the putative perfection of actual existence toward instead announcing existence’s total unreason: for admitting them into ontology is to admit existence as fundamentally beyond our anticipatory grasp, as riddled with catastrophe and risk, whilst pronouncing total deidentification of reason and nature such that, at the limit, nature can subsist without any rationality within it. Indeed, as opposed to the disidentification of reasons and existence propagated in earlier times by nominalist theologians, contingency was here no longer the remit of an omnipotent-yet-benevolent god, but, instead, was now native to an alien and autonomous nature: in other words, ‘extinction’ was finally

in a position to procure empirical determinations as a prospective causal event rather than remain a mere nominalist thought experiment.

Nonetheless, in disarticulating Leibniz's exhaustive embodiment of rationality as nature's interminable connective fascia of sufficient reasons, catastrophism put time entirely *out of joint*. This meant that, as previously entreated, all explanation is reduced to mere labelling (because nature no longer has any interrelated 'joints' to carve) and the rational tools required for coherent forecast (essential, indeed, to articulating X-risk as in any sense pragmatically meaningful) are entirely lost. In this, catastrophism follows its spiritual progenitor: David Hume.

5.4—shallow finitude, 1748

Hume accepts the localization of epistemic content wholesale and unflinchingly. This being the fundament of his empiricism, because, since total reality is aconceptual, we cannot go “beyond what is immediately present to the memory and senses” in our conceptual inferences concerning it [1992; 29]. We can never “carry our foresight beyond” this sensible basis [1992; 50]: hence, Hume's scepticism regarding the lawful, i.e. subjunctively-robust, language of both modality and normativity. Ultimately, “all our ideas are nothing but copies of impressions” and it is “impossible for us to *think* of anything which we have not antecedently *felt*” [1992; 41]. This represents a radical extensionalism: an attempt to reground concept-use entirely in sense-data, one that therefore sacrifices all concepts that do not immediately describe sensible objects (this, importantly, includes hypothetical realities and moral laws, for counterfactually-sound nomologies and subjunctively-compelling imperatives cannot be successfully derived from direct experience). And so, whilst Hume is certainly preoccupied

with finitude, his finitude (because of the fact he forgoes concepts that do not directly describe sense-contents) is by consequence capable only of being ‘weak’ or *de facto* and never ‘strong’ or *de jure*.

For though Hume’s problem of induction is indeed premised upon the idea that experience can never cover all natural instances in the world (thus acceding at least regional absences of experience relative to existence) his scepticism can never license hypothetical propositions upon the potential for experience’s absolute absence (because this requires usage of modally-involved concepts that do not directly describe). Humean finitude, that is, is populated by unobserved instances, but no unobservable ones, specifically because the committed empiricist denies the legalistic as well as modal languages propping these latter up (they involve, respectively, questions both of laws limiting possible experience as well as the hypothesized mind-independents shoring such limits up). Consequently, Humean scepticism can talk of innumerable unexperienced instances (and readily does so in order to undermine induction regarding nomologies [1992; 22]) but it discards the resources to talk of the end of observation *as such*. A shallow finitude, therefore, admitting only of ‘lacunae’ and never ‘terminus’: it is extensional and never intensional; or, merely enumerative rather than robust.

Not finding inferential principles (such as modal notions) immediately within natural human sense-experience, Hume (just like Cuvier) jettisons them entirely: but, in denying these theoretical inferences (as Whewell would identify them), Humeanism collapses explanation into labelling and sapience into sentience, insofar as we, firstly, lose the ability to track the implications of our descriptions relative to others (thus *justify* their propriety and firmness) and, secondly, abjure our capacity to articulate binding responsibilities. (This is integrally important to eventual X-risk awareness, insofar as it demands both capacities of us: normative and anticipatory dimensions

coalesce in our responsibility for—merely potential—future generations, and our attendant duty to try our strategic best to ensure their prospective existence.) Hume famously declared rationality can only be “slave of the passions” in ethical orientations [2003; 295]. Yet, in a globalized and industrialized world, sentient passions will not navigate us around grave risks threatening the very continuance of sapience. What dawning ‘risk society’ solicited of us, therefore, was an untrammelled acceptance of the voidance of concord between our concepts and external existence, yet one that, *pace* Hume’s own reaction, encounters such an expatriation as demanding an assumption of culpability for concept-use *in its entirety* rather than as abjuring such conceptual responsibility through recourse to a new foundation in the shallow horizons of sense-data. Hume, that is, accepted consciousness as interminably a precarious model rather than a microcosm insulated from risk, yet he couldn’t articulate the full dimensions of this precarity insofar as he missed that consciousness is a model capable of modelling itself *as* a model.

5.5—robust finitude, 1781

Cartesian radical doubt and Hume’s problem of induction equally commit to the localization of epistemicity and, indeed, this committal provides their very motivating occasion. Both philosophies, however, fall short of being able to generate coherent statements regarding existential risk and human extirpation. This is because they do not sufficiently *globalize jeopardy as an epistemic self-relation*: that is, both are stymied in this department by the retention of a crypto-Parmenideanism that, in seeking new foundations for thought in unmediated contact with existence (whether as intellection of “clear and distinct” concepts or sensible intuition of empirical percepts), ultimately regionalizes the recursive reach of contingency as reasoning’s tribunal of radical self-inspection. It would not be

long, however, until the loop of recursive risk would be closed; an achievement declared in the characteristic announcement that “ours is the very age of critique, and to critique everything must submit” [CPR; Axi].

Immanuel Kant’s critical revolution consisted in entirely redefining reasoning as essentially a self-legislating activity. Self-legislature is establishment of one’s bounds. Therefore, to reason is to progressively elaborate rationality’s own limits. This is because Kant realized that any straightforward description of empirical affairs, to be intelligible *as* a descriptive utterance, necessarily also involves tacit negotiations with practical dimensions within our semantic frame on said empirical world: to be acknowledged as applying any descriptive assertion at all we must be receptive to the bounds of apposite application for the contents asserted; thus, in a fundamental way, the business of describing and asserting is *simultaneously* the practice of negotiating and elaborating the limits of *correct* assertions.¹⁷ Conceiving of the limitations of concepts, moreover, is synonymous with becoming aware of their artifice and corrigibility (for Kant, this is couched in terms of triangulating them as “mode[s] of perceiving” that are “peculiar to us” [A42/B59]). Thus, extrapolating from this, an integral threshold in the unfolding of this discursive procedure is the immersion of *all* conceptual contents in contingency, or, undertaking self-reflection upon the insecurity of concept-use *as a whole*. This is why, though not yet explicit in the systems of Kant and his peers, articulation of human extinction (*qua* pinnacle explication of conceptual finitude’s entailments) is utterly essential, rather than alienable, to the post-critical construal of rationality as self-legislature.

¹⁷ This is the upshot of Kant’s “synthetic *a priori*”; whilst also being expressed in the notion of “schemata” and his ‘togetherness principle’ [A50-1/B74-6].

Simply put, reasoning concerning human extinction as an objective affair is legible simultaneously as reasoning upon reason's own pragmatic limits. Or, explicit utterances upon our prospective species extinction are implicitly also a prime act of legislative self-limitation—an apotheotic expression of finitude—and therefore cannot but be a cardinal achievement, inherent rather than foreign, to what Kant called “*Aufklärung*”. Hence, ultimately, why Kant's breakthroughs and the wider public's serious acceptance of X-risk are largely cognate within intellectual history.

5.5.1—responsibility & risk

Upon construing reason as globally (rather than regionally) self-legislating, or as a top-down rather than bottom-up architecture, Kant first allowed total withdrawal from all epistemic foundations: whether rational or sensible, metaphysical or empirical; no matter how surreptitious or tempting their promise of doxastic ‘insurance’ through unjustified justifiers and mythical givens may be; thereby entailing that rationality is, in a special way, *responsible only for itself*.

Though we are undeniably tethered to nature via sensation, Kant saw that sensation alone cannot provide an incorrigible ‘foundation’ because it cannot secure for us *reasons* to commit ourselves to (or undertake responsibility for) thinking nature as thus and so. Sensations can support reasons, but are never *be* reasons themselves, because these latter are always discursive in scope. And, on the other hand, because our discursive resources are clearly corrigible, neither can they provide a secure foundation in external existence. This retraction of epistemology from all *unmediated* foundation in existence, therefore, has two key results: 1) it signals human knowledge's debuting of total responsibility for itself, and 2) it institutes, as the precise obverse of the former, a globalization of jeopardy as reason's prime heuristic of self-relation.

This is because ‘being responsible’ for our utterances involves being receptive to their potential defeasibility or invalidation insofar as it is *only* through this that we, as discursive actors, enforce culpability for incorrect or infirm claims. So, in order to assume top-down self-responsibility, we must be capable of submitting *all* cognitive content—both sensible and inferential—to the tribunal of better reasons: inquiring into their propriety or validity, which, in turn, entails their submersion in riskiness. Thus, departing from circumspect foundationalism, Kant embarked upon a new course by realising that reason could not become fully responsible—or, culpable for the whole of its contents—unless it can put its entire dominion in jeopardy. One does not assume responsibility without undertaking risks, after all. And, indeed, this is how rationality comes to be capable of grasping its prospective terminus within nature as empirical prospect: by way of incorporating awareness of its own dislocation from any unmediated foundation within empirical existence in the form of resolute self-representation of the exhaustive precarity of *all* its contents. This, by the by, is why the path to the Kantian construal of autonomy is correspondent with the philosophical nativity of X-risk awareness.

Assuming full responsibility involves immersing reason, as a whole, in environing risk. Kant called this procedure “critique”. With this, the Kantian demand that knowledge assume accountability for itself becomes identical with dawning awareness of its precarity as worldly enterprise: full responsibility, ultimate stakes; no foundation, zero insurance. To risk oversimplification: *the globalization of critique is the articulation of extinction*. The latter, quite simply, arrives as the predictive datum of the former’s pragmatic dictum: the one is object-level entailment of the other’s deontic realisation. For, as with Ockham centuries prior, Kant’s withdrawal (by way of

his totalisation of the critique's reflexive scrutiny) of epistemic concerns from all unmediated foundation in mindless existence is exactly coincident with the subtraction from existence of all inherent propositional and epistemic contentfulness, such that—as collateral premise—we must be able to entertain propositions upon an (at least possible) world without any thought *überhaupt*. Yet, unlike Ockham and leagues of sceptics after him, Kantian philosophy is able, in addition, to *substantiate* this otherwise merely hypothetical supposition (i.e. of a mindless world), helping thereby to make it specifiable as a pressing issue *motivating* empirical research and real-world mitigation, by giving it 'pragmatic cash-value' and doing so precisely by being able to load it with the *theoretical-inferential* dimensions that alone grant it practical significance and moral weightiness as a real future prospect rather than a merely hypothetical 'limit case' posited simply to put nominalism into relief. (Indeed, it is the hortatory force of future X-risk—by way of extinction's unique deontic dimensions—as an aversive stimulus motivating pre-emptive strategizing that makes it 'pressing' as an empirical potentiality rather than a mere thought experiment.) This capability is entirely connected, indeed, to Kant's ability to secure his meditation *apropos* the insecurity of our entire conceptual pantheon and do so without collapsing into a damaging relativization of our theoretical-inferential resources that would, concordantly, foreclose our prognostic grasp of such 'futuribles' and their modally-rich implications. Indeed, philosophers up to and including Hume had committed wholesale to the localization of mindedness yet none had comprehensively allowed mentality to concordantly monopolize conceptual content in this way without concomitantly falling into an empiricist scepticism regarding the usage of the special class of *non-descriptive* concepts that license consequential and sturdy claims about the modally-involved scope of the very finitude that had

occasioned such localization in the first instance (insofar as doing so would require expressive resources—such as hypotheticals and counterfactuals—that empiricism jettisons inasmuch as they are not native to, or easily derived from, immediate experiences). In jettisoning this expressive class, empiricists simply could not accredit the unique non-descriptive dimensions of ‘X-risk’ statements nor appraise their moral weightiness. How, then, did Kant manage to navigate this tricky course? How could he ratify the expulsion of theoretical principles from reality, all whilst allowing robust use of the theoretical inferences that alone allow grasp of our future extinction as a meaningful event (both morally and predictively)? As hinted, it is because he clearly saw the practical dimensions involved in any and every declarative assertion.

5.5.2—modality as metalanguage

By classifying rationality as self-legislation, Kant unveiled concept-use as a question of deontology before it is one of ontology. Sensation anchors us to nature, but all sensation (insofar as we can be discursively aware of it) is mediated by principles, or concepts, not native to sense-experience (it is theory-loaded, in other words). Such “concepts” are not native to sensation because they are “rules”. Kantian concepts, that is, are *protocols of use*: legible as roadmaps of correct judgement. They are “rules for the exhibition of appearances” and the “functions” mapping out their space of apposite application [A246-7/B303]. This, finally, provided coherent grasp of mindedness’s late medieval expulsion from mindless reality: reasoning is alienated from brute existence (and can thereby ratify reasonings concerning its own potential non-existence) because it is through and through mediated by questions of ‘*should*’ and ‘*ought*’ irreducible to those of merely ‘*is*’ and ‘*are*’. Kant’s breakthrough consisted in demonstrating, *pace* Hume, that one could not deploy the latter vocabulary without

prerequisite grasp of the former, whilst also, *pace* early modern “dogmatic” rationalists such as Descartes or Leibniz, upholding clean distinction between the two.

Concepts, then, operate not because they *just are* natural facts or hold innate correspondences with them (as the dogmatist implores), nor are they operationally dispensable regarding our grasping of such facts (the empiricist’s gambit); rather, their indispensability derives from their *normative* (thus ultimately extra-factual) force.¹⁸ The point is that, following from this, concepts are not based in facts (they are “not derived from nature [nor] conform to it as their model” [B163]) because they are instead rules (charted by the subjunctive ‘*ought to be*’ rather than the declarative ‘*is*’) such that it can indeed be a coherent fact that there will be (*will have been*) no sapient concept-use at all.¹⁹ And, what’s more, in accordingly showing that not all vocabulary need refer directly to sense-contents and thus declarative facts in order to be discursively legitimate, critical philosophy also retained our expressive ability to state future perfect hypotheticals and anticipations (e.g. ‘there will have been no concept-users’), safeguarding them from their empiricist repudiation, by classifying them as such terms as are not derived from experience.

¹⁸ To flesh this out, one cannot apply any descriptive judgements regarding empirical data without prior sensitivity to the rules under which alone such judgements are appropriate or inappropriate, and such rules, insofar as they must cover unexperienced instances as much as experienced ones, cannot be merely reduced to experiential fact: it is only “in conformity” with concepts [A100], then, as the regulatory maxims that map out the *subjunctive* space of apposite application for declarative judgements, that our reports of sense-data gain the capacity to be truth-apt and, accordingly, became elevated from *sentient noises* into *sapient speech-acts*.

¹⁹ In this, Kant was first to *entirely* disentangle orders of justification and of existence, or reasons from causes: avoiding the mingling of the two that had long stymied stipulation of extinction by engendering metaphysical extravagances such as plenitude; for, to put it briefly, extracting deontology from ontology—bifurcating ‘ought’ from ‘is’—means that the ‘fact’ of the terminus of ‘value’ finally becomes comprehensible.

This is how Kant ‘closed the loop’ of recursive risk and was simultaneously able to support robust—rather than merely shallow—statements regarding such risk. Because, in noticing that some cognitive items (which he called “transcendental”) are defined by their normative or regulatory role rather than their origin in natural experience—by their explanatory functionality rather than descriptive veracity—Kant allowed modal terminologies to become paradigmatic of this former class, thus saving them from their Humean degradations, and he did so by subsuming modalities under his “Categories” (which stand, for him, as exemplar cases of cognition’s regulative devices). These “Categories” are metaconceptual, in that they are concepts that enable us to talk *about* concepts: “[t]he principles of modality”, Kant elucidates, “predicate nothing of a concept except the action of the faculty of knowledge by which it is produced” [A235/B287]. Through this, modalities are finally fully revealed as the artefacts by which reason models itself *as a model* (embedding within itself its precarious—as opposed to microcosmic—status, and thus, at the limit, incorporating propositional awareness of its own terminus as the foreclosure of all empirical experience). In more detail, modals are what allow us to track what we *mean* when we commit ourselves to any declarative assertion (as opposed, that is, to modals being themselves straightforwardly matters of declarative assertion): because, instead of solely stating correspondences between concepts and facts they, instead, act primarily to outline and police the space of consistency within which all of our descriptive concepts necessarily hang together (in subjunctively-robust relations of compatibility and incompatibility) and from which they alone derive their meaningfulness and significance *as specific descriptors*. That is, Kant noticed that ‘correctness’ (a notion requisite to understand any empirical assertion *as an* assertion) is an inherently normative affair and thus must, in order to function, be considered as

intensional rather than extensional: i.e. it must be seen as implicating a subjunctive space of possible use, covering potential instances as much as actual ones (and thus not at all fully specifiable solely in terms of the latter). Consequently, modals are what allow us to map this space and understand what we *mean* when we talk. Following this, terms like ‘necessity’ and ‘impossibility’—though seemingly deriving their role from describing empirical regularities—are elucidated as primarily articulating the subjunctive spaces of apposite use for empirical-descriptive contents by elucidating the discursive laws that underpin their appropriate and inappropriate deployments. And, of utmost importance, Kant saw that the former ‘descriptive’ usage is semantically dependent upon (i.e. logically posterior to) the latter ‘pragmatic’ one. The same goes for the term ‘possibility’: *explicitly imagining the world as otherwise is implicitly self-reflecting upon the corrigibility of our perceptions regarding it.*²⁰ Thus, rather than narrowly fact-stating utterances, modalities provide the normative metalanguage within which we can track the contingency of our utterances.

With this, Kant fully de-naturalised modal concepts, such that they could refer, globally, to the unnaturalness of our concepts—i.e. their lack of necessary foundation in nature—and thus, *mutatis mutandis*, also to the potential inexistence of human concept-use as worldly enterprise: for, only by entirely uprooting notions like ‘contingence’ from any foundation in correspondence (a gambit achievable solely by way of explicating their *extra-factual origins* in normativity) is contingency first able to become *fully* reflexive and self-referential. The loop is closed. For, despite the fact that the outlines of a similar view of modality (i.e. as rooted in coherence *contra* correspondence) begin

²⁰ Kant exemplifies this relation when he de-absolutizes own mental architecture by way of imagining the potential existence of other “forms of intuition [and] forms of the understanding” [A230/B283].

emerging as early as al-Ghazālī, a comprehensive and internally-coherent account of modalities as holding *no* necessary root in matters of fact only becomes fully cogent with the Sage of Königsberg (by way of his clarification of the ‘normative’ rather than ‘natural’ root of certain cognitions). Indeed, though the medieval theologians had moved modals away from any root in ontology, they had invariably retained for them a theistic (thus inevitably dogmatic) basis in the ‘mind of God’. Kant, on the other hand, because he instead explained modals as primarily regulative and normative, could suspend plenitude regarding external nature (thus averting the path that reifies every conceptual possibility as a fact such that one cannot countenance the fact of conceptuality’s possible end) and could do so, unlike the theologians and nominalists, not by reference to some dogmatic *potentia absoluta* but simply by endorsing nature’s entire lack of inherent rational structure: consequently allowing this latter to be legible as a factitious and secular matter; one that can therefore accommodate the objective event of human extinction as an entirely naturalistic happenstance.²¹

Thus, emancipated from all root in correspondence (either in sensation, as habit; in metaphysics, as plenitude; or, in theology, as divine choice) modalities, as metaconceptual tools, can now comfortably and confidently refer to the end of correspondence as such. Contingency could become

²¹ This is also why Kant, hereby dispensing “*cosmologia rationalis*”, can bracket concern for the ‘cosmic totality of natural instances’ that Hume was tacitly referring to in his enumerative problem of induction, and instead consider nature as lawful only insofar as it is considered the “totality of appearances” [A114]. We cannot say if noumenal nature is ‘lawful’, but phenomenal nature *must* be (and we note the deontic force of the ‘must’ here). Indeed, despite Kant’s own unfortunate choice of wording on the matter, this does not mean that lawfulness is entirely subjective or “spontaneous”: it means, rather, that we *must* grasp uniformity (or “affinity” in Kantian parlance) as a methodological regulator and normative maxim (motivating *update* of our lawlike models in response to incoming data that contravenes them) rather than a substantive factum. Thus, something ‘earned’ rather than ‘given’: the givenness of which would speciously reintroduce a crypto-Parmenidean identity between naked being and conceptual justification.

fully recursive, and, because it is predicated of concepts rather than facts (referencing norms rather than nature), it can coherently describe the natural *fact* of the end of *concept-use* and do so as an ultimate self-acknowledgement of conceptual limits. Or, in other words, concept-use can acknowledge its existential closure because concepts are rooted in norms rather than existences; and norms, being lawful, are inherently in the business of legislating their own bounds. This, indeed, is why articulating extinction is legible as an ultimate act of self-policing. And, to close, we note that it is exactly the robustly lawlike aspect elicited by this that strengthens ‘finitude’, elevating it from harmless ignorance into *incoming threat*.

5.5.3—noumena=extinction

Because, for Kant, ‘*ought*’ necessarily comes before ‘*is*’ (and the latter depends on the former: insofar as any declarative sentence involves subjunctively-involved conditions of truth-aptness), critical philosophy fundamentally revealed that the paradigmatic expression of cognitive limitation is robust and *de jure* rather than simply enumerative or *de facto*. The limits of human experience, that is, were unveiled as a rational (i.e. rule-governed) matter over and above being a nakedly empirical or sense-based one (i.e. subject simply to the fickleness of sensible faculties); and, precisely because laws, as already explained, are defined by their ‘subjunctive robustness’ (or ability to support counterfactual instances as much as actual ones), this means that we must be able to map out such limits with counterfactual *limiting cases* rather than merely the vicissitudes of actual experience. And so, as an ancillary commitment, ‘finitude’ (as the parochialization of mindedness within nature) gains a new—and infinitely stronger—significance and moral force.

In asking “*quid juris?*” Kant made finitude *intensional* rather than merely *extensional*: it is anatomised by necessary and sufficient conditions under which any and all possible experience holds, rather than being demarcated shallowly by the happenstance of merely actual experiences. (Hence why Kant enthrones “division into the possible and impossible” as the “highest concept from which all transcendental philosophy” embarks [A290/B346].) And, inasmuch as intensional claims are counterfactually robust, Kant (in order to make finitude intensional in the way he wants in order to derive a mappable and holistic space of possible experiences) is required to put the limits of experience into relief through use of counterfactual conditionals which involve hypothetically postulating the possible non-existence of any and all human thought. *Hence, why ‘extinction’ becomes a supplementary premise and necessary consequent of the transcendental endeavour.*

Point being, though not yet gaining empirical determination as a prospective event in causal order, Kant is here employing all the requisite preliminary work required to express human extinction explicitly and overtly. For, where Hume had counterfactually pictured a world without any uniformity and had modestly inferred that it would end the enterprise of inductive science, Kant employs the self-same thought experiment, and takes it far further by being able to license the stronger inference that, should this ‘Hume-world’ indeed be actual, there could be “*no experience at all*” [A112].

Throughout the critique (and frequently in the ‘Transcendental Deduction’), Kant deploys such conditionals in the operation of shoring up intensional limits for human cognition, each time necessarily positing a potential non-existence of any and all discursive experience in order to paint these limits into relief, all the while engendering counterfactual cases wherein “no experience would be possible” [A653-4/B681-2]. These conditionals, indeed, are the devices that instate Kant’s

favourite cartographic metaphor—his comparison of reason to a “sphere”—for they are the self-regulating judgements that upgrade the boundless miasma of Berkeleyan or Humean phenomenalism into the navigable topology of rule-governed rationality: a ‘boundless’ yet ‘finite’ sphere. Yet they can only do so by way of jurisdictions upon the *noumenal limits* of phenomenality: jurisdictions which take the expressive manifestation of conjectures picturing a subjunctive foreclosure of *all* human thought, as epistemicity’s “negative extension” [A255-6/B311-2].

Judicial limits require extrajudicial relief—or “negative extension”—such that the corollary of critique is extinction: and the concept of the noumena is their point of contact. In establishing the ideality of our everything, Kant opened the door to the reality of our nothing. Or, put differently, to have been able to announce the notion of “noumena”, one has already grasped everything one needs to grasp in order to exposit the mutability of *Homo sapiens* and its rational project. Though tacit in scientific and counterfactual imagination since modernity’s dawn, it is only with Kant’s philosophy that all the requisite cognitive modules are constellated such that the covert implication can be made overtly explicit. It should come as no surprise, then, that, as previously covered, Kant became increasingly preoccupied with the prospect and problem of human extirpation as he aged.

6—CONCLUSION

In sum, the historical coequality and conceptual adjacency of critical rationalism and X-risk awareness lies in this: *contra* dogmatic rationalism, Kantianism commits to the expulsion of concepts from foundation in nature (allowing conceptions upon a concept-forlorn noumenality) whilst simultaneously retaining their functionality, *contra* empiricism, as metaconceptual tools that do not directly describe actual experiences because they instead map out experience’s possible limits

(enabling surveyance of the *unobservable* in addition to the merely *unobserved*), and Kant can navigate this novel course precisely because he notices concepts as ultimately normative rather than naturalistic (eliciting sensitivity to subjunctively-involving law rather than merely brute fact, thus allowing finitude to become rigorously *counterfactual* as well as nakedly *de facto*, and consequently capable of supporting conditionals upon human extinction scenarios as well as trees falling in unpopulated woods). To extend his cartographic imagery, only post-Kant does finitude index not only those coordinates on the map that we haven't yet visited, but, additionally, also those places that are beyond *any feasible map*. Though not yet clear in Kant's writings, this is what upgrades finitude from mere ignorance to pressing threat—from agnoseological triviality to actuarial concern—inasmuch as it paves the way, in part, for later consolidations of futurological forecast by fully explicating the absolute extent of our incertitude in the face of existence, and, given newly strengthened sensitivities to the scope of limitations upon our experience, critical philosophy thus also institutes the conditions that *motivate* true mitigation. As ever, total responsibility involves immersing the staker fully in the stakes of her game: or, in other words, in step with us becoming aware of its expulsion from any foundation in existence we simultaneously realise that human reason exists, and continues to persist, only through its accountability for the ever-ramifying entirety of its beliefs, such that—eventually colliding *aletheia* with species survival—we realise that, at the limit, *we know ever better or potentially never again*. Indeed, undertaking self-responsibility strips the world of all moral culpability such that humanity becomes Promethean and self-assertive to the very extent that it becomes ever more apparent that Promethean projects are liable to be extinguished irreversibly and inconsolably. (Humanity, indeed, notices its influence over global climate *just as* global climate

—toto mundo destructo—

emerges as an existential threat.) This is what Kant sensed but PBS could not. For, despite PBS's reference to it in the epigraphs to *PU*, there can be no Archimedean point: for just as reason reasons better by becoming aware of its corrigibility, humanity only becomes more stable and leverages increasing power over nature by acceding that we are ever more immersed in a widening horizon of total instability. *For it is this acknowledgement alone that motivates us to predict ever better.* Only through this does mitigation—and thus, perhaps, security—begin.

‘THE FULLY ENLIGHTENED EARTH RADIATES DISASTER TRIUMPHANT’: EXTINCTION and GLOBALITY

To be human is to refuse to accept the natural as naturalistic, and to take full responsibility for such a refusal.

—Luciano Floridi

0—INTRODUCTION

Prognoses upon the precarity of our species project, as expressive collateral of human rationality’s assumption of total culpability for the entirety of its conceptual contents, cannot but enlist the notion of ‘the Universal’ in its enunciation. For, just like the coeval announcement of “Enlightenment”, extinction’s utterance cannot but enmesh us in global prospects—of totalizing scope—inasmuch as, whether one acknowledges it or not, it outlines a prospect that concerns *all* reasoning animals alike. It is no coincidence, then, that ‘extinction’ and ‘universality’ are, historically, coincident notions; insofar as talking about existential risk necessitates sensitivity to ‘the absolute’ in semantic affairs.

Talking with total objectivity, nothing whatsoever would be at all ‘special’ concerning our physical senescence as a biological species (to the contrary: extinction is the biotic rule, not the exception; whereby 99.9% of all species that have ever existed are extinct [Raup, 1991; 3-4]). And yet, talking in an equally legitimate register, we note that we are the sole sapient animal and, thus, that we alone expressively instantiate, uphold, and navigate the world in terms of unconditional values requiring no basis in physical facts-of-existence, whereby the loss of this normative endowment can *only* be suitably described in terms by which the loss will have been ‘absolute’. It is our endowment

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of semantic competence—not our physiological germline—that can properly be said to *matter* and, moreover, to *matter absolutely*. And this is because, insofar as the loss of value is not only a physical event, but likewise one of semantic and normative proportions, its significance cannot be exhausted simply by specifying its spatiotemporal vicinity or local aetiologies alone, and, therefore, it can only be appropriately spoken of absolutely and in absolute terms.¹

Accordingly, it is no surprise that the enunciation of ‘X-risk’ is wrapped up in that of ‘globalization’—materially, historically, and philosophically. This chapter explores this claim across three, adjacent themes.

First, by studying the issues involved in affording communicable expression to the notion of ‘human extinction’ (insofar as picturing the loss of *all* human sensoria involves imagining a world beyond all sensory picturings and, accordingly, necessarily emerges first as a ‘contentless’ metacognition upon the limits of perception before gaining any perceptual, and thus narratable, ‘content’) we present a delineation of some of the methods of counterfactual address necessarily adapted in order to grant reason’s hypothetical terminus narratable contents (given the obvious difficulties inherent to representing the absolute closure of representation). How does a narrative embed, within itself, the end of all narrativity? As we see, it could only do so, in these early stages of the notion’s career, by exploiting the recursion of nested frame-narratives, or, model-worlds.

¹ Thus, why extinction is ‘astronomical’ in scope. Though, of course, extraterrestrial intelligences, probabilistically speaking, *should* exist [Vakoch, 2015]. This was a qualification Kant himself was, rudimentarily, alert to [Louden, 2014; xx]. After relating all material inference to probabilistic “betting” [CPR; A825/B853], Kant goes on to use the example that he is willing to “bet” his entire wealth that there are extraterrestrial civilizations!

Secondly, we trace an inevitable semantic entwinement between emerging discourses of globalization and nascent prognostications upon future termini, due their homologous origins in critical rationalism's explication of the ineliminable role of the unconditioned in knowledge (given that both notions are alike progeny of Kantian reflections upon the autonomy of reason relative to merely local or factual horizons: elucidating a lack of foundations enacts the dynamics of deracinating globality as much as of sensitization to existential precarity). Turning to analysis of MWS's *Last Man* and its chronotopic features, this homology finds narrative expression as an identification between the teleological tendencies of globalizing universalism and the future prospect of human extirpation. Surpassing PBS's materialist soteriology and his backsliding foundationalism, MWS rejects such metaphysical insurance schemes and—by modelling telic identities between globalizing reason and pandemic extinction within her novel's narrative crucible—she ingeniously provides counterfactual relief for the proposal that humanity only asserts itself within the world to the degree that it further immerses itself in enveloping risk.

Thirdly and finally, we explore the effects of human rationality becoming, in this way, 'feedforward conversant' with the risk of its own future closure: locating this 'conversancy' as a form of practical entanglement, inasmuch as, like any edict of universal scope (i.e. Kant's categorical imperative), the forecast of global extermination, no matter how phenomenally intangible, tangibly impinges upon our behaviour in the here and now (strategizing, planning, etc.). We must understand this, purely *deontically*, as the exhortation to mitigation. Nonetheless, a string of philosophers were quick to overstep critical limits and misconstrue this 'future-orientation' as instead *ontic* in range, mutating reflection upon future perfect terminus from a regulative injunction (comprising ultimately hortatory

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imperatives regarding aversion, action, and future-oriented responsibility) to a substantive transaction (whereby extirpation becomes inflated as future perfect *telos* such that talking of extinction is in fact extinction talking through us). The inorganic voice recrudesces. Through this, we unveil the fact that human extermination takes on a centrally important—though unnoticed and forgotten—position within post-Kantian idealism (and, in particular, the career of German pessimism), whereby the irreducibility of the transcendental over the empirical was fatally misinterpreted as being substantive—rather than normative and semantic—in remit, such that the transcendental’s ‘ontological austerity’ (a direct result of its autonomy relative to natural fact, as concerning ‘*ought*’ rather than ‘*is*’) became reified as a metaphysically-inflated thesis concerning reasoning’s alienation from ‘being’ itself (which, as in Carlyle’s diagnosis, was construed as existentially damaging). In tandem with this, the extra-factual (because ultimately deontic and regulative) origin of philosophy’s ‘absolute’ became hypostatized as an annihilating emptiness relative to existence, such that, seeking reaggregation with this primordial nothingness, human rationality was fatally cast as a vehicle for the manifestation of *absolutized extinction*. With grand extravagance, therefore, totalized extinction transplanted the Hegelian absolute as the drive and destination of cosmic evolution, whilst our own vociferous death was revealed to have been the protagonist of “*Weltgeschichte*” all along. We close by warning against this irresponsible and post-Romantic tendency to become enthralled by the ‘posthuman’—and its promise of radical difference—and the concomitant tendency to install this ‘thanatropic escape’ as some new philosophical absolute or *telos*: inasmuch as this tendency is rife, if implicit, across many schools of thought today, given theoretical fads of ‘anti-anthropocentrism’. *Homo sapiens* may not be the be all

and end all of ‘intelligence’, but it is all that sapient intelligence currently has, so it must be treated with the responsibility that such intelligence—by its very definition as binding committal to self-improvement—demands. As Negarestani [2018] points out, to live in the ‘prehistory’ of true and genuine ‘posthuman intelligence’ likely requires being truer to ‘the human’ than ever before.

Thus, keeping in mind these salient expressive symmetries between ‘the absolute’ and ‘human precarity’, we will address these three questions:

- 1) How does one enunciate ‘nowhere’ and ‘nowhen’ from within the ‘here’ and ‘now’?
- 2) What effect does this enunciation have upon the locality that enunciates it?
- 3) How is it, therefore, that the unconditioned speaks through us? *What does it demand?*

1—GLOBAL SPREAD

Given the above, it is fitting that (just like enlightenment itself) as soon as the notion of human extinction became explicable within one context it inexorably spread further afield. In previous chapters, we have focused predominantly upon English, French, and German thinkers: in this chapter, we move beyond these confines. We start with the Italian arch-pessimist, Giacomo Leopardi.

Leopardi, a figure comparable to PBS in many ways [Cerimonia, 2015], was a reader of Cuvier [Sims, 2012; 14]. Appropriately, he brazenly alludes to human extinction more numerous, and more unforgivingly, than any other writer of his generation. In his final poem ‘La ginestra’ [Leopardi, 2010], the crippled poet compares “loving nature” to a “cruel nurse” who, when the “human race [...] fear it least”,

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with the slightest movement in a moment
partly destroys,
and can with movements not much greater
suddenly totally annihilate

[ll.43-8]

In the *Operette Morali*'s 'Dialogue between Nature and an Icelander', Leopardi stages a confrontation between this "cruel nurse" and an Icelandic interlocutor [1982; 184-9]. Nature, uncaring and flippant, explains that it takes no heed when it "harm[s]" entire populations "in any way". In concluding, Nature cruelly expounds that "even if I happened to wipe out your entire species, I wouldn't notice it." The Icelander, in response, protests that organic life did not choose to live—and thus to suffer this fate—to which Nature responds, glibly, with the platitudinous reply that all destruction is merely part of existence's "perpetual cycle of production and destruction": all is upcycling "conservation"; all is harmless plenitude. By the time of writing (1824-32), this well-worn sublation no longer convinces nor placates, however; and the Icelander, decrying sophistry, interjects that this "is just what all philosophers say". In response to this, the Icelander—a helpless plaintiff—is simply obliterated, without ceremony or sentence, by one of Nature's myriad forces. This marks not just a mortal terminus for the Icelander but dramatizes a wider discursive and judicial cataclysm also: the abrogation of the ancient ideal of bilateral dialogism between nature and mankind, whereby mutual responsiveness—allegorized here as judiciary debate—empties out into irrecoverable loss and silent injustice, jarring conspicuously with Nature's own insidious dissimulations of dialectical plenty and overflowing creativity.

Elsewhere, in his equally gloomy 'Copernicus', Leopardi allegorizes the revolution instigated by the eponymous astronomer by presenting a personified Sun that chooses to rebuke prior uniformity's authority (perhaps having read too much Hume) and refuses to continue illumining the Earth,

abjuring its ‘duty’ to benefit humanity. Terrestrial extinction is forecast: for “when the last spark of fire is no more, [humanity will] all die in the dark, frozen like pieces of rock crystal” [1982; 419]. (We recall Galileo’s inorganic crystal-world.) The “rolling from the centre towards X” that Nietzsche diagnosed of Copernicanism [2003; 84] is here literalized—with our sterilized planet rolling off into cold, dark space.

Most unflinching of all Leopardi’s vignettes of extinction, however, is his ‘Dialogue between a Sprite & Gnome’. Therein, upon being asked where the species of “devil men” have all got to, the sprite replies to the enquiring gnome that “They are all dead” [1982; 87].

We learn that “their race is lost”. The gnome is shocked, however, that “a whole species can be completely lost”, to which he is duly reminded that “a master geologist” and spelunker, such as himself, should know better (given the vast amount of “petrified” facsimiles of vanished fauna underground [1982; 90]). The two discuss how, given humanity’s absence, the “days of the week won’t have names anymore” and yet they “will continue” and that no one will “print calendars” yet seasons won’t cease: thusly dramatizing extinction’s reliance on a chronometric—thus entirely de-semantified—notion of time that is excoriated of hermeneutic and calendric significance. Deep time switches into deep futurity, stripped of experiential content and phenomenal property. The same exorcism of meaningfulness further seeps into questions of axiology, with the duo laughing at the ‘waste fertility’ of terrestrial nature now that humans are not here to utilize its resources (again, an inverted plenitude: for naked existence, when divorced from rational concerns and interests, becomes behemothical unreason to the exact extent of its superabundance). Ultimately, the sprite describes that
now

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they are all gone, the earth doesn't feel that there is anything missing; and the rivers aren't tired of flowing, and the sea doesn't seem to be drying up, even if it's no longer used for the traffic of ships.

[1982; 95]

Leopardi was writing from Italy in the 1820s, yet, from around then until the 1840s, 'extinction' would spread much further afield: creeping across the globe. To the East, Russian Prince Vladimir Odoevsky, friend of Pushkin and a major figure in Slavic intellectual life, had produced an 1825 piece entitled 'Two Days in the Life of the Terrestrial Globe' which occupies itself with an oncoming cometary collision and the effects on polite society of the forecast the "[t]he Earth will be shattered to bits" [2010; 150]; to the West, Edgar Allen Poe, by 1839, had penned 'The Conversation of Eiros and Charmion', which pictures another approaching extraterrestrial missile, inexorably triggering human extirpation, upon impact, through "combustion irresistible, all-devouring, omni-prevalent, immediate" [1976; 70]. Both tales identically took inspiration from Biela's comet, a stellar body that John Herschel had infamously predicted would eventually return to collide with Earth ("a singular recontre, not unattended with danger" [1833; 310], the astronomer glibly wrote) causing much public consternation (the comet was often projected, in popular sources, to "blot [us] out from the Solar System" [Burrill, 1833; 251-2]).

The terminality native to these presentiments concerning planetary-scale extirpation, however, is mitigated by the *frame* of each tale. In order to access humanity's future perfect graveside, Poe's narrative of cometary extinction is presented from the safe perspective of the title characters' position in the spiritual afterlife; whilst Odoevsky's piece, packaged as a humorous parlour conversation at a countess's soirée, largely utilizes impending X-risk as the looking-glass within which Prince Vladimir can reflect the pettiness of Russian metropolitan socialites. A prolific social commentator, Odoevsky masterfully juxtaposes the existential horizon of all human value with the parochial concerns of the

soirée that provides the piece’s occasion and setting; and, nestled within this comedic juxtaposing, facetiousness and chagrin are equipoised, with the weight of Odoevsky’s punchline teetering between either belittling scientific speculation upon largescale threats or belittling humanity’s small-mindedness and insipience in the face of them.² This notwithstanding, Odoevsky’s cometary annihilation is ultimately averted and the piece concludes ‘in a Schellingian aura of benign apocalypse’ [Cornwell, 2015; 37]. (During the 1820s, the illustrious Odoevsky was the centre of Moscow’s ‘Wisdom Lovers’ or ‘*Lyubomudry*’ circle: Russia’s first proper philosophical salon, the group proved instrumental in importing post-Kantian ideas; interestingly, Schellingian *Naturphilosophie* took centre-stage in Russia’s idiosyncratic reception of idealism.)³ That is, Odoevsky’s extinction is averted and it is relayed that our planet begins to draw closer to its star and, concordantly, the “Sun became the Earth and the Earth the Sun” [2010; 154]: just as in *PU*’s georevolution, a coruscating utopia is instated as the Earth’s mantle peels forth with millenarian light and extinction is sublimated by way of solar apocatastasis.

² The socialites are presented enquiring into whether the planet can be saved from “shattering” upon cometary impact. Echoing Byron’s Promethean vision of steam being used to neutralise incoming cometary missiles, the countess’s guests discuss whether “machines” and “defensive positions” can “repulse” an asteroid’s “fiery cleft”. This descends, at length, into trifling debate concerning our species’ ultimate fate: Odoevsky’s narrator reports that “[t]here were no disasters [to which] the terrestrial globe was not being subjected” as the guests, by turns, “were burning it in fire, drowning it in water” and so forth. The discussion develops, eventually, into parlour game, wherein attendees guess each other’s favoured extinction-scenarios, thereby demeaning human terminus into salon amusement [2010; 148-54].

³ Though disbanded after 1825’s Decembrist uprising (only two years after being founded), the Wisdom Lovers became central to Moscow’s intellectual life and were of ‘pathbreaking importance’ during this embryonic phase of Russian philosophical self-consciousness and self-assertion [Kelly, 2016; 18]. As we see below, the circle also provided seedbed for the specifically Slavic reformulation of Romantic extinction narrative.

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In this way, Odoevsky, in 1825, presages attitudes from the other end of the nineteenth century: namely, the work of Camille Flammarion, whose 1894 *La Fin du Monde* is framed, identically, as a public debate occasioned by the approach of a deadly comet, wherein scientific and academic interlocutors catalogue a surfeit of future extinction-scenarios (from combustion of the atmosphere to planetary desiccation; from global refrigeration to stellar attenuation) whereby “our planet will be at a loss to choose among so many modes of death” for the “entire population of the globe” [1894; 113]. At the last moment however, Flammarion abruptly segues from this gloomy taxonomy of termini into a resounding descant on the “inexhaustible” nature of plenitude and its unbroken cycles of cosmic “resurrection”: within which terrestrial humanity *may* perish, but in the *fullness* of plenistic time, “new humanities” and “new civilizations” must necessarily and inevitably arise, for “[n]othing can be destroyed”. It ends transposing Hutton’s mantra to the cosmos: “there can be neither end nor beginning” [1894; 280-7].

We raise Flammarion here to note that, despite a brief flare of unalloyed engagements across the 1820s and 30s (constituting the current chapter’s core focus), narrative depictions of *true terminality* thereafter largely disappear for the remainder of the century (recrudescing again only in the late-century speculative fictions of authors like J.-H. Rosny aîné, M.P. Shiel, and H.G. Wells). Though Flammarion, on the surface, appears to deal with human extinction, his novel actually presents perhaps the most extravagant sublation—and thus also *trivialization*—yet exemplified. This perfectly examples how, not long after extinction first became fully articulable, well-worn prejudices were resurrected and retooled in order to defang its prospect once again. We refer to a reinvigorated confidence, conspicuous throughout the Victorian era, in plenitude and progressivism—largely

consequent upon early receptions of Darwinism. Directly relating it to Odoevsky's 'Terrestrial Globe', however, Flammarion's novel also demonstrates how framing was often deployed to buffer any 'threat' invoked by narrativizing human precarity. That is, from Odoevsky to Flammarion, frames operate to *contain* and *mediate* the shock of extinction by nesting it within some higher-order apologia or affirmation: this normally operates, indeed, via implicit re-assertion of some foundationalist cliché like plenitude; often hidden and disguised, however, underneath the vestments of new-found discoveries such as Darwinian evolution. ("We need not marvel at extinction", Darwin himself had written: this being because he assumed *perfect equilibrium* between creation and destruction—or speciation and extirpation—throughout terrestrial history [1859; 320-2]. Such assumptions, and their conclusions, licensed returned faith in plenitude's axiom of a net homeostasis of variations. Accordingly, Victorians, for their part, were more concerned with *degenerating* into a lower being, as opposed to passing out of being entirely. This likely explains extinction's mid-century 'disappearance' as a pressing issue.)⁴ Thus, the frame often acts to *isolate* the present-day articulator of extinction from the pragmatic entailments of her articulation (insofar as, defined by its 'future-orientation' and 'feedforward conversancy', the act of seriously prognosing future X-risk—and its human costs—changes *what it means* to think and act in the present). And yet, despite the development of such techniques of containment, narrative frames, as we are set to explore, also

⁴ As already implied by Lyell's future "more intellectual beings", terminus was also neutered by Victorian interpretations of evolution as supporting and evidencing teleological cosmologies [e.g. Chambers, 1994]. Consequently, whilst Émile Zola could, in 1875, pen dialogue pronouncing that "the death of the human species is preferable to the abomination [of its continuation]" [2017; 94], he would elsewhere personally confide that "more perfect beings" will *inevitably* evolve after the "extinction of the human race" as he was convinced that evolution entails a "flood of life [never] diminishing" [cf. Walker, 1984; 50-1].

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proved a necessary technique when it came to the very first narrative explorations of the idea, and, moreover, they did not always act toward abating the conceptual severity of the scenarios elicited therein. Certainly, prior to the adaptation of philosophical ‘antibodies’ (such as Flammarion’s ridiculous vision of cosmic dying-and-rising), earlier narratives are, precisely because of this nascency, often more potent in their depictions. Odoevsky, indeed, would soon encounter and read MWS’s 1826 *Last Man*—for which he penned an 1827 review published in a Moscow journal attached to his *Lyubomudry* circle—which, in turn, provided impetus for the Prince to pen his own version of MWS’s narrative, a vision which, unparalleled in its intensity, resists the moderations of any possible framing piety. We turn to Odoevsky’s unique extinction scenario for our conclusion: for now, we note that, from American to Russia, speculations upon X-risks had, across the 1820s, become widespread and viable.

2—OPERATIVE FRAMES

History—considered here as the arena of humanity’s self-understanding of its chronologies—becomes increasingly ‘contingent’ only in step with our expressive capability to assert ‘how it could have been otherwise’ (i.e. to place actual events alongside a multiplicity of ‘mere possibles’ that could alternately take, or have taken, place). Properly speaking, then, the events of history are only ‘contingent’ by way of being put into expressive relief against a range of counterfactuals; or, to pronounce actual history as ‘contingent’ is entirely dependent upon prior expressions of merely counterfactual alternatives; and so, the scope of ‘historical contingency’ indexes, in this precise sense, the space and depth of our subjunctive locutions. (‘History’ is a question of self-conception as much

as material change: though this distinction is itself largely artificial.)⁵ This ‘space’ is incarnated, in part, within cultural artefacts and, specifically, literary output. Literature, so to speak, is where we mediate our understanding of history’s ever-widening ‘parameter space’ to ourselves. This is why one sees a shift, within modernity, toward representational modes governed by *plausibilistic* criteria (such as the realist novel or speculative fiction) and away from the more *ostensive* modes of elder forms (e.g. prophecy, allegory, or folklore). As an extension of this logic, the latter eighteenth century emergence of ‘time-travel narratives’, ‘future fictions’, and ‘hypothetical histories’ is both a reaction *to* and active facilitator *of* the period’s self-understanding of itself as one of socio-political revolutions and expanding possibilities. (Gallagher, writing on the eighteenth century origins of counterfactual histories, traces to this period the birth of the understanding ‘that we can develop a more accurate knowledge of historical events simply by placing them in context of their reconstructed alternatives’ [2018; 26].) The horizon of expectation was ramified by extensions of the methods by which our shared language and its cultural artefacts embed the proliferating ‘state space’ of history’s variables and possibilia; and, as this horizon (alongside its auxiliary fields of ‘chronometry’, ‘futuraity’, ‘contingence’, and ‘risk’) seceded from experiential horizons, more elaborate and self-conscious techniques of mediation were inevitably required. In response to this, an important threshold of self-awareness concerning this dynamic was achieved through new utilization of literary frame-narratives. We refer to a technique, gaining popularity throughout the late eighteenth- and early nineteenth-

⁵ For example, the events of the French Revolution were ‘*unprecedented*’ not so much in terms of concrete fact relative to material conditions but in terms of their *conceptualization* as epochal thresholds [Halimi, forthcoming]: the power of such a ‘conceptualization’, nonetheless, unleashed tangible world-changing effects.

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centuries, wherein the traditionally veridical and plainly truth-stating operation of an editorial frame is *exploited* in order to instead point toward self-consciously non-veridical frame-contents and, therefore, by referring to its own lack of ostensive reference, the text foregrounds its suppositional standing, thusly opening itself up as a space for counterfactual experimentation. This functions to announce the *heterocosmic* status of the interpolated text: flagging it as ‘crucible’ for the manipulation of mere *possibilia*. Through this, the text achieves self-consciousness of its role as a mediation and articulation of (the currently acknowledged range of) contingency. Its merely hypothetical status, thereby, becomes ‘*operative*’. This is integral because it enacts the sophistication of address demanded for narrative depictions of entirely as-yet-unexampled possibilities such as human extermination or global collapse. Certainly, the procedure by which a narrative artefact recursively refers to its own lack of ostensible referent betrays functional isomorphy with the higher-order, cognitive capacity of mind to discursively track its own artifice relative to reality: thusly gesturing to why it was that such ‘framing’ panned out as so indispensable to early narrations of the potential extinction of mindedness as such. We have previously seen how any overt scientific assertion describing properly mind-independent objects covertly comes bundled with wider modal commitments pertaining to the limitations of experience itself, such that all talk of a world *sans* reason involves implicit self-reflections upon reasoning’s own propriety: and, in referring to its own lack of concrete reference, the narrative frame is performatively enacting and enjoining a symmetrical call to self-reflection; that is, narrativizing events beyond all actual experience is always also a pragmatic triangulation of the limits of possible experiences; through this, literature’s function as discursive mediator of our grasp of historical contingency can come, through thus reaching self-awareness of this role, to additionally

incorporate depictions of the contingency of discursive practice *simpliciter*. Depicting X-risk scenarios, indeed, provides *the* ultimate counterfactual relief against which to *assess* the scope of actual history’s challenges; providing a space of ‘what-if’ conditionals against which we can measure the instabilities of our own experience of history against the simulated revocation of history and experience itself. It is no coincidence that Eva Horn referred to Byron’s poetic forecast of collapse in ‘Darkness’ as a ‘hypothetical anthropological stress test’ [2014; 65]: ‘human extinction’ becomes the ultimate *counter-to-fact limit case* through which and against which we can specify and stake out the intensional contents of the historically-unfolding concept ‘human’.

Operative frames, as ‘crucibles’ within which to legislate our self-conception by simulating our own precariousities, crystallize the ways people contemporaneously parsed contingency and its lately extended reach (given new-arisen fields from linguistics, anthropology, to geoscience): as such, the framing devices mobilized by extinction narratives are key to our understanding their significance. They take multifarious forms. From occupying the discursive register of scientific simulation, to modelling self-contained cosmologies, to dramatizing states of ‘magnetist somnambulism’, to the innovation of time-travel as narrative device, even the body of the earth became a frame-device employed to elicit expressive exploration of the very limits of the plausibility and possibility of ‘history’ itself.

2.1—inostensible frames

Some frames are flagged, explicitly, as thought experiments. Edward Wallace’s *Last Man* of 1839, for example, is prefaced with the self-proclamation that the “following [is] less a tale, than a sketch to enliven thought” [1839; vi]. We have already encountered Richter’s ‘Rede des toten Christus’, which

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very clearly functions under the aegis of an ‘*if...then...*’ conditional: enabling Richter’s modelling of a universe in which the putatively counter-to-fact statement ‘atheism is true’ fulfils the role of antecedent (‘*if...*’) to the conditional consequent (‘*then...*’) and its depiction of annihilation. Richter’s conditional provides the frame by which the revocation of vital and noetic absolutes can be mapped out. Such a setup, furthermore, grants Richter an alibi—given the theologically volatile implications of this endeavour—insofar as he uses the frame to assiduously state his goal is to refute atheism through *argumentatum ad consequentiam* (the salient *consequentia* being human extirpation), and that this vouchsafes “excuse for [the] audacity” of his vision [1992a; 179]. Jean Paul stresses this so as to keep the frame-contents under appropriate counterfactual ‘quarantine’ (i.e. maintaining their strictly didactic-hypothetical intention), yet, given the uncompromising ferocity of the ensuing vision, one can viably argue that the sheer *enárgeia* (a rhetorical term for persuasive vividness) of the scenarios modelled therein destabilises any apologist intent and thus breaches said authorial ‘quarantining’. (This pinpoints the integral role of thought-experimenting in shifts of theoretical paradigm. A worldview becomes ‘reoccupied’ from within: whereby the commonly-accepted ‘factual’ view is internally usurped by suitably coherent explications of its supposedly ‘counterfactual’ alternatives; such that, what was once ‘counter-to-fact’ becomes, eventually, asserted as ‘fact’. We see this, for example, with Descartes originally disguising his mechanistic ontology as a mere “imaginary” game [1985; i.90]. Concerning the ‘Rede’, Richter’s pietistic frame can be cast as unintentionally incubating its own insurrection by way of its frame-content so coherently and persuasively depicting the death of its own deity.)

Indeed, it was largely due to fear of censure that speculative prognostics upon extinction often had to emerge under the ‘camouflage’ of apologist frames. Thomas Campbell’s popular 1823 ‘Last Man’ represents an instance of this, by concealing terminalist prevision within chiliastic envelope. Campbell’s poem, nonetheless, is interestingly presented as a dream (granting the narrator’s spirit “strength to sweep / Adown the gulf of Time!” [ll.6-7]). A similar example of ‘oneiric framing’ is found in the anonymous ‘Last Man’ published in *Blackwood’s* in 1826, which utilizes the suspension of veracity denoted by dreamtime as a hermeneutic insurance policy (it ends up with the narrator awakening—laughing off his visions of planetary desolation—and thanking God’s grace [anon., 1826]). Presenting us with yet another instance of oneirological framing, we turn to Byron’s ‘Darkness’: which, rather than using the interpolation of dream-within-frame as a means of ‘quarantining’ volatile content (as the others do), instead exploits the very ambiguity such nesting can engender, in order to instead intensify the destabilization between ‘fact’ and ‘counter-to-fact’ that Richter’s ‘Rede’, in spite of itself, suffers from.

Writing during 1816’s *annus terribilis*, ‘Darkness’ presents perhaps the most famous literary expression of extinction to emerge from the period. It opens thusly:

I had a dream, which was not all a dream.
The bright sun was extinguish’d,

[ll.1-2]

With the undulation between “dream” and “not all a dream” is folded the entirety of the ensuing chronotope and its procedural rendering of the outcomes of a globe starved of light and become “[s]easonless, herbless, treeless, manless, lifeless” [ll.77]. We shall come back to the ‘substance’ of the frame-content, and its simulation of biosphere collapse, below. For now, however, we note that its

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entire diegesis is nested within the opening suspension between ‘dream’ and ‘not-dream’. This entreats a state of equivocation (‘is this unassuming and meaningless dream of the future, in fact, meaningfully future perfect?’), we are entreated to ask). The poem’s self-reference to its own equivocal status of ostension—and the lack of any hermeneutic closure supplied on the matter—actually works to intensify the conceptual threat of the contents rather than mitigate it: and this is because it works to announce that the contents therein, and any unease provoked by them, are to be arbitrated by a criterion of *coherence* and *plausibility* (as is, indeed, the expressive occasion of all counterfactual conditionals) rather than by any criterion of *extensional* or *ostensive* availability. Therefore, Byron’s opening equivocation cleverly shifts our gauge of severity away from adjudication by way of prior availability within experience and, instead, towards the more appropriate tribunal of sheer conceptual consistency (as detached from any necessary foundation in prior availability). Thus, such historical events as are depicted therein may never have been attested by *any* experience or prior history, but, the frame’s equivocation brings attention to the fact that—insofar as ‘experience’ doesn’t exhaust plausible possibilia—this does not negate its likelihood and *we thus cannot rule it out*. And so, Byron’s ‘dream-frame’ gambit ingeniously works to in fact intensify, rather than denude, the unease provoked by never-before-encountered X-risks.

We return to the career of dream-frames below. For now, we focus upon a structurally cognate method: one that identically exploits a framing suspension of ostensible reference as the surrogacy for articulating merely counterfactual cases and testing their plausibility divorced from all historical actuality. It involves the editorship of ‘non-existent documents’—the curation of hoax texts—borrowing a technique from the cultural discourses surrounding ‘the Gothic’ (e.g. *The Castle of*

Otranto) but also ‘Curiosity’ more widely.⁶ For, in foregrounding their own hoaxed nature, such ‘found documents’ once again foreground their inostensible nature as an enjoinder to treat the subject-matter as plausibilistic thought experiment rather than veridical reportage, thus exploiting framing equivocation, again, as opening a space within which to simulate and assess outlier possibilities divorced from questions of factual availability.⁷ The perfect setting for sampling extinction, in other words.

Leopardi employs this in various works depicting terminus (both human- and cosmic-scale). His ‘Canticle of the Sylvestrian Rooster’ (framed as a bricolage of various sources, from “Targumic” to “Talmudic”, and “found in an ancient parchment” of unknown provenance) extrapolates contemporary notions of terminalism beneath this guise of ancient occult hoax-text. Therein, claiming that all vitality necessarily contains a homeopathic “particle of death” (by which organism staves off and defers total collapse by collapsing constantly in mitigative amounts), Leopardi experiments therein with the nascent intuition that, insofar as (in the absence of plenitude’s symmetry) all cosmic evolution is now defined by irreversible “withering away”, everything we call progress is just a luxuriant detour on the downward slope to universal terminus (in modern parlance:

⁶ Curiosity, as a form of desire occasioned by self-awareness of epistemic lack, is historically related to contingency’s extending range and scope, insofar as both, identically, rely upon the ability to represent the limitations of representation: thus, why articulations of finitude and compulsive scientific curiosity are congenital and coincident within early modernity. Only by knowing what we do not, do we become motivated to inquire into it [Inan, 2012]. This reflexive aspect of curiosity was instantiated in a playful tradition of cataloguing flagrantly fake curiosities and fictional objects [e.g. Browne, 1684]. Leopardi’s ‘found documents’ partake in this rich tradition. More generally, ‘curiosity culture’—as reliant upon cognition’s capacity to track cognitive limits—is non-trivially related to culture’s wider sensitization to cognition’s corrigibility and, thus, eventually, to expressions of its existential finitude.

⁷ We borrow ‘inostensible’ from Inan [2012].

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all local negentropy increases net entropy such that all upswelling complexity is, in fact, a self-exaggerating form of global dissipation [England, 2014]). “Every part of the universe hastens indefatigably toward death with marvellous determination and swiftness”, Leopardi writes. Again taking aim at plenitude, he purposefully disabuses his reader of any residual presumption that, throughout countless deaths, there is equilibrium at the level of cosmic ‘whole’:

The time will come when this universe and nature herself will be no more. And just as of very great human [empires] there remains no sign of fame whatsoever; so too of the entire world, and of the infinite vicissitudes and calamities of all created things, no single trace will remain; but a naked silence and a most profound quiet will fill the immensity of space. Thus, this stupendous and frightening mystery of universal existence, before it can be declared and understood, will vanish and be lost.

[1982; 377-9]

A similar scenario is found in Leopardi’s ‘Frammento apocrifo’, which is framed with an editorial “Preamble” introducing the eponymous fragment as the translation of a long-lost metaphysical tract, lately rediscovered, and with murky pedigree. Interestingly, the fragment compacts a self-containing cosmogony: tracking from formation to termination. Encompassing an entire miniature universe, Leopardi extrapolates along its time axis in order to operatively stage the reneging of many popular sublimations of terminus: it is reported, indeed, that many like to think of nature’s “continual perishing” as in fact a “continual transformation” and, accordingly, conclude that “destruction is continuously balanced by production” (as even Darwin would later assume [1859; 320-2]); and yet, in a form of ‘embedded refutation’ commonplace to thought-experimenting (e.g. Malthus’s disassembling of utopia by way of depicting subsistence failure), Leopardi’s chronotope instead models the plausibility of total cosmic disintegration without hint of reversibility or recompense. (Leopardi stages sublimations in order to procedurally dismantle them.) That is, aping scientific reportage, he forecasts that our globe will, over time, be gravitationally distorted into a torus, before

centrifuging entirely: “it will break into pieces”, which “will precipitate into the sun”. To close, Leopardi projects the same rotiform fate for all cosmic bodies: concluding with the prediction that *all* matter will centrifuge and decay “for the same reasons” [1982; 381-89]. Note the appeal to lawlike consistency and induction. Indeed, it is precisely by mimicking the ‘time-stepping’ procedures (or, ‘time axis manipulation’ [Krämer, 2006 & Kittler, 2017]) typical of scientific simulations, that Leopardi tactically emulates their rigor and discursive authority, so as to lend more plausibility to his long-term revocation of plenitudinarian presumption.

In this technique, Leopardi was not alone: others employed similar occupation of scientific discourse in order to lend plausibilistic credence to their models. We have already encountered Mercier’s rendering of global refrigeration in his vignette entitled ‘Globe’ [1785; i.22-6]. It opens with the invocation “Newton imagined...”, thusly flagging itself, implicitly, as a rerun of Newtonian ‘computations’. As explored, it extrapolates the Newtonian prediction that nature’s “immense machine” will become “discomposed by the friction of its own activity”. Newton, for his part, had argued that this would only happen *if* God stopped continual tweaking and renovation of the system; writing in less faithful times, Mercier calls bluff on Newton’s counter-to-fact clause, actualizing it within his vignette and playing out its long-term implications. The Parisian chronicler’s vision of Earth’s deorbiting takes identical form to Leopardi’s above: a model-based refutation of time-symmetric presumptions. And, again just like Leopardi’s, Mercier’s relies on implicit allusions to computational time-stepping in order to pilot the experiment: both mobilize, that is, the fundamental post-Galilean assumption of time as an *independent variable* that can be manipulated relative to the target-system and its kinetic laws. (This being the basis of the later intuition—previously seen on

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display in William Herschel—that *the entire universe* is itself a “chronometer”.) Using this understanding to shuttle toward the ‘end of time’, Mercier simulates nature’s regularities dissolving. “Attraction losing its force”, he writes, the “planetary system” would come unbound, causing “terrible phenomenon”: his vision ends, just like Byronic ‘Darkness’, with our “depopulated” planet projected as “rambling in the void space”. Notably, one of Byron’s many plagiarizers similarly chose to draw out the ‘celestial mechanics’ of this deorbiting process in his own imitation of ‘Darkness’: talking of earth “err[ing] from her fixed course” and—“widening her circles still”—careening into sterile space [Reade, 1829; 171]. The plotting of such trajectories would not be alien within Euler or Lagrange. “Rayless and pathless”, our planet, in Byron’s original, eventually refrigerates, and—“void” of the “populous and powerful”—it is left to wander interstellar expanses as a “lump of death” and “chaos of hard clay” [ll.69-72]: an inorganic hulk, the incarnation of Galileo’s previously implausible sterile planet, as ‘vital’ and ‘populous’ as the cooled iron globes lying in Buffon’s basement. Indeed, just as Buffon’s *in vitro* experiments subordinated the planetary whole to a purely chronometric notion of time emptied of all phenomenal properties, we note that it is an identically de-semantified notion of temporality that Leopardi’s, Mercier’s, and Byron’s experiments all inherit—and make imaginatively operative via ‘time axis manipulation’—in order to hypothetically plot the deep future. Where Leopardi, however, used the hoax-text technique to get there, Byron commandeered a dream.

2.2—oneirological frames

“Dreams, books, are each a world”, Wordsworth claimed [‘I am not One who much or oft delight’, ll.33]. Containing an entire world (and its collapse), Byron’s ‘Darkness’, aside from

piggybacking scientific notions of time for its endeavour of ‘proscopic’ forecast, is suitably framed oneirologically. (Mercier’s ‘Globe’ is positioned proximally: published in Mercier’s *My Nightcap*, which, as the title suggests, is collocated as a series of ‘night thoughts’.) The Byronic setup—of a dreamtime aperture onto distant futurity—proved influential.

There is a state of being—but what name
to give it? It is neither sleep nor waking.
It lies between the two, and in a man
it is the place where madness borders reason.

[II.1-4]

These are the opening lines of the 1827 poem ‘The Last Death’ by Yevgeny Baratynsky [2015], renowned for his overpowering elegiacism (possibly rival to Leopardi in this department). It is no coincidence that these lines closely recall ‘Darkness’: Byron’s poem, that is, had become ‘firmly rooted’ in Russian literary culture across the 1820s and 30s, being translated ‘at least five times’ in the prior decade, whilst having provided ‘poetic impulse’ for a train of emulations and translations by Slavic poets [Diakonova, 2004; ii.341].⁸ Like Odoevsky, Baratynsky was another member of the Pushkin circle, also becoming close associate of the disbanded ‘Wisdom Lovers’/‘*Lyubomudry*’ circle after moving to Moscow during 1826 (significantly, it was the *Moskovskii vestnik* journal—the organ of the ‘Wisdom Lovers’—that was instrumental in transmitting Byronic ‘Darkness’ to Russia; furthermore, it was also here that Odoevsky published his review of MWS’s *Last Man*, in the same year that Baratynsky wrote his ‘Last Death’) [Baratynsky, 2015; xlv]. Given recent turmoils in Russia

⁸ In 1830, Mikhail Lermontov [1983-4; iv.372] rendered ‘Darkness’ into prose (translated as ‘Тьма’). In 1847, Turgenev translated it once more, instancing a moment of Anglo-Russo cross-fertilization that was called upon again—a century later—during escalating Cold War tensions and prospection of incoming nuclear holocaust [Rudolf, 1984 & Kapitza, 1985].

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(i.e. the crushed 1825 Decembrist revolt, the perceived failure of rational humanism, and post-revolutionary despondency), ‘extinction’ caught fertile root.

Accordingly, Baratynsky’s ‘Last Death’ begins picturing ‘uchronia’ (i.e. the temporal transposition of utopia), delineating the perfect technoscience of the coming age, before segueing into total extinction. Here, the human species is irreversibly wiped out: leaving only a *post festum* vision of “deep silence”—“majestical and solemn”—wherein planet earth is returned to primordial “melancholy” [ll.85-9]. Thus, just as in PBS’s dream in *Laon & Cyntha* (cf. pp.57_n), oneiric vision becomes the submersible for dropping into the deep future, plummeting to the temporal nadir of our extermination. That is, inhabiting the trope of temporal dilation during dreaming (we recall De Quincey’s discussion on the “dreaming organ” altering our chrono-receptivity [2009; 135]), Baratynsky’s narrator describes himself telescoping through centuries. “[T]he years that are to come revealed themselves”, and

Events arose, unfolded, undulated
like billows of cloud, and from time to time
they coalesced into entire epochs,
before my eyes assuming visible form,
until, without a veil, at last I witnessed
the final destiny of all things living.

[ll.19-24]

Edward Wallace’s *Last Man*, previously mentioned, similarly utilises the dream as device for prospection upon the “Shadow of dark Futurity”: utilising dreamtime as conduit to fast-forward to the “dark oblivion” of “age’s verge extreme”, wherein aeons “obscure the sun” [1839; 1-2]. The oneirological becomes ‘chrono-locomotive’ device, manipulating time just as scientific models do. In Baratynsky’s case, he conspicuously recapitulates Byronic vacillation between ‘dream’ and ‘not-dream’ by equivocating as to whether his presentience is “disordered fantasy” or the “conception of

a mind audacious” [ll.15-6]. Again, such self-reflexive suspension forecloses any possibility of interpreting this as ‘prophecy’ (as this latter is predicated on the certitude derived from speciously presuming no distinction between cognitive and non-cognitive orders) and, in averting its apprehension as ‘prophecy’, the recognizably modern idea of ‘time-travel’ emerges in its place.

As explored, modernity’s motivating occasion for forecast and rational prognosis is time’s loss of any inherently intelligible shape and hermeneutic contentfulness—itself occasioned by the evacuation of propositional structure from independent reality—which, in turn, sets up the scientific ‘de-semantification’ of chronology under the guise of science’s conversion of nature into time-bound transformations governed by mathematical laws: in this, the ‘future’ likewise loses all intuitive determinacy prior to its arrival (and thus also refuses all inbuilt compliance to undertakings classifiable as ‘prophecy’, ‘apocalypse’, etc.) such that, having become radically epistemically ‘distant’, we must now *travel* to reach it (whether using frame-devices or, as was the case later in the century’s fiction, mechanical machines). Or, when chronology becomes de-semantified, ‘time-travel’ replaces ‘prophecy’ as the conduit for narrating distant futures: no longer the repository of indwelling and self-manifesting moral significance, temporality, in the hands of modern ‘time-travel’, is reconfigured as an *independent variable* governing physical transformations, and, thusly voided of semantic content, becomes a parameter to be manipulated like any other (hence, ‘time axis manipulation’). Very basically, ‘time-travel’ apprehends epochal duration as *quantum*, ‘prophecy’ apprehends it as *quale*. And, before Wellsian engines could gloss this as a mechanizable process, the dream-frame operated as a crude and prototypic *time-machine*—used here to access humanity’s graveside. Indeed, the first canonical ‘time-travel’ narrative is none other than Mercier’s massively

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popular *L'An 2440*, which (opening with an epigraph from Leibniz: “*le Temps présent est gros de l’Avenir...*”) is framed with an opening address which sees Mercier’s narrator beseech “the Future” and proclaim “could I but behold thee otherwise than in a dream”: tellingly for our purposes, this ‘Epistle Dedicatory’ then proceeds to vacillate between appraising optimistic projections of future uchronia and pessimistic previsions of total collapse, before, eventually, leaning toward the latter.

But [delivered] from the illusions of a pleasing dream, I fear, alas! I fear,
that [Futurity’s] sun is more like to cast a gloomy light on a formless mass of ashes
and of ruins.

[1795; i.3]

Once more, Promethean projects are Promethean to the precise extent that they are precarious. Mercier is likely here imagining the deathbed of Paris (a hobbyhorse of his [Mercier, 1781; ii.323-7]) rather than the entire human race, but it nicely demonstrates that the wider shift from ‘prophecy’ to ‘time-travel’—attendant as it was upon the excoriation of propositional contents from chronology—was utterly cognate with futurity’s wider redefinition as ‘incoming undefined threat’ rather than ‘indwelling apocalyptic insurance’. Byron, Baratynsky, and Mercier’s dream-state frames, therefore, are all identically distinct from millenarian prophecy—and are capable of interpolating projections of future extinction—precisely because they use their frames to foreground, rather than foreclose, the founding fallibility and incertitude of their content. For, as ever, it is only after strategically acknowledging unpredictability that one *realises* one must predict rather than rely on prophesy.

Revealingly, one of Byron’s readers reacted expressly to this aspect of ‘Darkness’ by penning a critical emulation of the poem, seeking to amend its threatening incertitude by shutting up the plausibilistic space opened by the ‘dream’/‘not-dream’ vacillation and, thereby, aiming to collapse

‘fallible prognosis’ back into ‘prophetic augur’. We refer, that is, to an anonymous poem—written under the curious pseudonym ‘Harlequin Proteus’ [1824; 85]—which, after closely imitating the imagery of Byron’s ‘Darkness’, concludes thusly:

At least, when all are dead, that world itself,
Of nothing form’d, shall into nothing fall!
This is no dream—or, if it be a dream,
Then it be prophetical.

Through this, Proteus attempts to recuperate and reinstate the ‘hermeneutic closure’ that characterises prophetic certainty, as opposed to fallible futurology, and thus reground the old-fashioned ‘sense of an ending’ over the newly-articulable ‘ending of sense’. This is a direct rejection of the acknowledgement of mental finitude (and, by corollary, also precarity) that occasions and motivates historicist forecast and prediction; thus, Proteus’s emendation betrays a reactionary desire for return to circumspect foundations and their insurance systems (both existential and epistemological). For, again, in self-consciously flagging and promoting its own lack of ostension within experience, the Byronic frame-narrative is transacting in tacit awareness that experience and ostension cannot exhaust the range of total historical possibility: Proteus, clearly sensitive to this, responds by attempting to collapse the framing vacillation back into the securities of the plainly “prophetical”.

One last example of dream-framing perfectly exemplifies the way that new vocabularies of futurity were replacing these elder categories. We refer to Odoevsky’s own time-travelling uchronia, written in 1835-40 and entitled *4338-Й ГОД* therein, under cover of a dream-frame, Odoevsky experiments with a new lexicon of ‘futures’. The significance of the title, translating as *The Year 4338*, is the calculated return, according to “[a]stronomers’ calculations”, of “Biela’s comet”, which, it was

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predicted, “must certainly collide with the Earth” in “2,500 years” [Odoevsky, 1982; 38]. (Funnily enough, this year was based upon a common misinterpretation of Olbers’s probabilities on comets, where many misread him as saying that a comet would definitely collide with earth in *precisely* 2,500 years [Lynn, 1867; 210].) Hence, reprising the prognosticated X-risk scenario of his ‘Terrestrial Globe’ piece (and the “extreme emergency” and “threat of the comet” through which all “life” may “come to an end”), Prince Odoevsky’s narration reaches and depicts this critical juncture in terrestrial history through the frame-device of an editor, who, engaged in “Mesmeric experiments”, self-induces a “somnambulistic trance” that catapults his “vision” deep into the future, so as to know “the condition of the human race one year before that terrible minute [of impact]” [1982; 38]. As a forefather of twentieth century Russian cosmism [Young, 2012; 16-7], Odoevsky projects a resplendent, uchronic vision of future Promethean technologies (high-speed global transport, hemispheric terraforming, pneumatic flight, etc.) all poignantly juxtaposed against the impending X-risk of cometary collision: significantly, Odoevsky, in his prefacing notes, justifies his predictions of such radical and unprecedented socio-political change across future human history by comparison to Cuvierian palaeontology, through citing the contingencies of prior natural history that “Cuvier has proved” (“how many species have disappeared from the face of the earth” it is stressed [1982; 42]—nature is filled with “Истребление”, or, ‘extermination’). From this, Odoevsky sketches a kind of crude propaedeutic to futurological speculation, nodding to “[t]he author of *The Last Man*” (i.e. MWS) who, Odoevsky reports, “tried to describe the last epoch of the earth”. He abstracts from MWS’s methodology what he dubs a “general science of foresight” (“общую науку предвидения”—the latter word denoting ‘prognostication’ and ‘prediction’), wherein one extrapolates “in a natural

fashion from the general laws of human development as recognised by science and art” to forecast the “far future” and the customs of “the coming age” [1996; 47 & 2013].⁹ Thus, though he was still relying on ‘somnambulist visions’ for his aperture, Odoevsky clearly is struggling toward a recognizably modern lexicon of futurological speculation. Prior to Wellsian time-machines, one had to rely on the crude “machinery [of] dreaming” (as that “one great tube through which man communicates with the shadowy”) [De Quincey, 2009; 135], yet, despite this inchoateness, the fundamental conceptual coordinates of recognizably modern ‘futures literacy’ are in place.

3.3—speleological frames

It is telling that Cuvier figures so prominently in an early time-travel narrative. (Odoevsky’s utopia also describes a vast museum in future St Petersburg—described as a “miniature version of the entire planet”—presenting, in aeonic order, all of palaeontology’s extinct “flora and fauna” [2013]). Indeed, exploring one last category of framing-device, we see how, in lieu of Wellsian machines, the stratigraphic body of the earth itself became symbolically charged as the portal to alternate chronologies and counterfactual histories.

Two years prior to 4338, Odoevsky’s countryman Osip Senkovsky had, in 1833, written a tale entitled ‘Scientific Journey to Bear Island’ [Senkovsky, 1994] that, similarly engaging the idea of cometary collisions, depicted the cave-descent of a team of scientists followed by their subterranean discovery of curious hieroglyphs appearing to recount the history of a long-lost civilization

⁹ Throughout his speculative fictions on “Russian Enlightenment”, Odoevsky uses ‘futurity’ as the optic within which to put Euro-Slavic divisions into focus: namely, pitting Western economism against Eastern collectivism. Appropriately, ‘futurity’ latterly became a space of fierce contestation during the Cold War: splitting Soviet-approved Marxist-Leninist ‘social prognostication’ from Western ‘bourgeois futurology’ [Toffler, 1972; 197].

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extinguished by extra-terrestrial impactor. (These ‘glyphs’ later turn out to be nothing but random pockmarks, much to the scientists’ dismay—again playing with hoax-text and inostension.) Nine years prior, another Russian uchronia, in the form of Faddei Bulgarin’s *Plausible Fantasies, or a Journey in the 29th-century* [Bulgarin, 1982], employed the now-familiar conceit of falling asleep and waking up a thousand years later. Significantly, the setting for the narrator’s chrono-locomotive slumber is a cave. Moving from Russia back to Britain, we note that 1826’s anonymous *Blackwood’s* ‘Last Man’ piece has a similar setup, concerning a dream and a cave-mouth.

It is thus notable that both Grainville’s and MWS’s ‘Last Man’ works similarly open with their editors undertaking a speleological descent. The narrative contents of both texts are embedded and framed as some kind of cryptic message—of self-consciously questionable provenance—discovered deep within a cave.

“Near the ruins of Palmyra there is a solitary cavern”: thus starts Grainville’s “Romance in futurity”, with a katabasis into this “subterraneous abode”. Our narrator is drawn inside—despite seismological rumblings and pyrotechnic emissions from the cave’s mouth—and enters “utter darkness” and “void space” within. Soon, the narrator comes across the Delphic Tripod of Apollo, for whom “futurity is known”. The Tripod declares itself as “father of pre-science and dreams” [1806; i.1-6]. Such “*pressentimens*” (as the French original has “pre-science”) allow navigation of “dark futurity”, whereby the Tripod will “make thee a spectator to scenes that will terminate the destinies of the universe”. It is declared that:

The last man will not have any descendants who can know and admire him.
My desire is that before he is born, he will be known in memory.

[1806; i.7]

Encapsulating the temporal gymnastics involved in memorialising the end of mnemonics, this is how humanity supplies its own epitaph.

Turning to MWS's *Last Man*, we encounter a similarly oracular cavern. Here, MWS utilizes the cave's chthonic interstice in a manner functionally similar to Byron's inostensible framing in 'Darkness': she uses the cave-space, that is, as a space within which veridicality can be suspended. Her novel opens, that is, with MWS's editor dropping into the cave of the Cumæan Sibyl. Within the depths, the editor stumbles upon "leaves" and "fragments" covered in mysterious writings. Hinting immediately toward temporal anomaly, dialects from "ancient Chaldee" to "Egyptian hieroglyphics" are present—imbricated and interleaved within "modern dialects" [LM; 3]. Here time cannot be fully linear. The quires, mingling the factual and counterfactual, tell of unreal histories and plausible fictions: an archive recording events as have never (yet) happened and chimerical chronicles, not at all fantasy yet neither fully fact. At every opportunity, MWS *intensifies*—rather than diminishes—indecision regarding the ostensible status of the documents. (The cave remains pristine and untouched, insinuating that this is no hoax, whilst the "leaves" certainly "seemed to contain prophecies"; yet, contrarily, such "scattered and unconnected" documents clearly communicate counter-to-fact and never-yet-actual events and, unmistakably, are of impossible provenance [LM; 3-4].)¹⁰ This, then, is an underground cache of *ontological apocrypha*: containing history's own dubia. Our editor, having collected multiple sheets, duly goes about "deciphering these sacred remains" and the ensuing novel—communicating the future history of extinction—is presented as the chronicle

¹⁰ In the 1720s, J.B.A. Beringer recovered 'fossils' with seemingly prophetic inscriptions; it, famously, turned out to be a ruinous hoax perpetrated by colleagues [Beringer, 1963].

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compiled from these editorial labours. Thus, MWS's frame, just as with Byron's, purposefully *inflames* the inostensible status of its contents: the purpose being, again, to shift the principle of their appraisal away from any criterion based exclusively in extensional availability, and, instead, towards a tribunal premised purely upon conceptual consistency and intensional coherence—detached from the merely local authorities of actual experience and occurrence—wherein lack of previous empirical availability is no obstacle to mapping out the plausibility of such outlier possibilities as lie beyond not only all prior observation but observability *as such*. Again, in the incipience of the notion of X-risk (and of 'futures literacy' generally) this was how such notions were necessarily framed so as to delicately navigate their novel 'futurable' status.

Why, then, is the occasion for something as seemingly 'non-concrete' as plausible futures so often located, deep within stone, underground? Aside from obvious precedents for 'prophetic caves' in the epic tradition [Louden, 2011], we can trace the of curious collocation of 'speleology' and 'futurology' to more modern, secular roots. We refer, namely, to the upheavals in horological notions catalysed by geohistory: for, ultimately, the 'cave+futurity' collocation draws upon the fact that, within general cultural consciousness, the geological site had become symbolic locus for geoscience's wider reorganization of time along a purely chronometric basis that, crucially, was entirely unbound from the constraints rationally presupposed within human experience.

Kant had noticed that time is a condition presupposed by experience rather than a concrete object of it. This helped him articulate a radically "formal" definition of time: the innovation of which lay in it being the first philosophical explication of a temporality voided and relinquished of *all* experiential content and its relevant constraints [CPR; A34/B50]. This has been cast [Greenspan,

2000] as part and parcel of modernity's long-durational abstraction of horology from sidereal circulations within experience (*calendric time*) towards a blank ordinality no longer defined or measured by experiential cycles (*chronometric time*). Another clear example of 'de-semantification', this was first attendant upon late-medieval breakthroughs in clockmaking: for, 'by its essential nature [the mechanical clock] dissociated time from human events' [Mumford, 1963; 15], a process only expanded by increasing standardisation and accuracy across coming centuries. Eighteenth century geoscience and the discovery of deep time can be clearly seen as expediting and intensifying this trend. As already explored, Buffon's proto-thermodynamic experiments had made the entire planet nothing but a "chronometer"; in this, time becomes abstracted from its previous empirical basis as the measure of the motions of bodies *within* experience, and instead comes to subsume *all* bodies and experiences as their framing condition; time is not dependent upon objects, but all objects, without exception, are the flotsam of time-as-independent-variable. This can be traced further back to modern geoscience's beginnings in Steno's 1668 stratigraphic Law of Superposition, which, by translating the layered planetary body into a line of temporal succession, implied that all observable 'body' is just a sedimented glaciation of time. And so, from mechanical escapement clocks, to geognostic discoveries, to the transcendental aesthetic, temporality was increasingly divorced from the strictures of empirical contentfulness.

These 'strictures' of empirical content are the various maxims and functional principles presupposed by objective conscious experience. As explored, these include higher-order cognitive regulative notions like uniformity—alongside principles of sufficient reason, plenitude, and continuity—as well as categorial concepts like 'body', 'quality', and 'objecthood', along with ground-

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level intentional features such as distinctness, solidity, or vividness. Put simply, it was increasingly clear that the emerging notion of formalized time was abstracted *from all such constraints*.¹¹

Aristotle had, long ago, declared that “[t]ime is the number of motion” and that it admits of the “*synecheia*” (i.e. infinite continuity) that he elsewhere identified with living bodies [2014; i.372]. It is, indeed, a condition of manifest experience that it concerns itself with embodied objects and tangible durations, but it was progressively clear that this was not a condition of the chronometric temporalities announced by modernity. Indeed, regarding the constraints placed by experience upon time, Kant writes that

We should [say] that common perception teaches us that it is so, but not that it must be so. These principles are valid as rules, under which alone experiences are possible; they instruct us prior to experience, not by means of experience.

[*CPR*; A31/B47]

(The rules we apply to organise temporality are only of “subjective” necessity, as Kant would put it.)

Thus, we note that pre-modern and peripatetic temporality is ‘jointed’ or ‘embodied’: by which we mean it is *naïvely identified* with our subjective demand for an uninterrupted and interminably continuous ligature of justifying reasons alongside the stipulations of sensible and somatic tangibility *presupposed* by conscious and embodied inquiry (i.e. the framework that we wrest upon experiential contents in order to schematize them). On the contrary, formal and abstract time is ‘disjointed’ and ‘disembodied’, in that it is relinquished from necessitous compliance with such presuppositions.

Exactly as was the case in Cuvier’s theorization of catastrophism, the extraction of such principles/presuppositions from substantive foundation in external nature led to a misguided sense

¹¹ Again, this is not to say that reality breaks ‘lawfulness’ or ‘causality’, but that we cannot *presume that this is given ahead of inquiry*, because such notions are “regulative maxims”.

of their invalidation altogether as guiding (and necessary) “rules” of our experience.¹² Accordingly, geological sites such as caves—insofar as they symbolized, for the contemporary mind, the effects of geology’s wider reorganization of time—came to serve as places where ordered and factual time was imagined to break down and become refracted into an nonlinear array of counterfactual alternatives, hypothetical futures, and unrealised pasts.

Coleridge, talking of earth as the “great archive of the past”, envisioned receding, “[s]tratum below stratum”, down through the sedimentations of “histor[ies] distinct from [those] of the foregoing [layers]”, whilst, ultimately, realising that this retrogression would raise problems as to “[w]hithersoever this may lead us, and however long our journey may be”, because one may find no “re-commencement of a cycle” that would end-stop the process and, by locating some substratal body around which time can thereafter be said to revolve, thus reincarnate chronology as a property dependent upon objective and tangible things (rather than being detached from such horizons such that the conditions of experiential ‘objectivity’ become themselves subject to disembodied time). Indeed, upon sensing the subjective threat insinuated by lack of some fundamental pivot, Coleridge imaginatively travels even further back—back before the accretion of Earth and further out toward the creation of the solar system—in search of the underlying cardinal joint. He cites theories, held from Buffon to Schelling, on the planetary system being created by catastrophic stellar explosions: theories which, instead of implying a pivotal point upon which to reembody a “cycle”, leave only implication of ever elder discontinuity and ever more primordial rupture. Coleridge finds such

¹² This, again, because of absence (prior to Kant) of a philosophical metavocabulary within which to distinguish between *regulative* presuppositions and *substantive* realities.

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retrogression-without-recommencement disturbing, and rejects the premises, because they imply (cosmological) time is disembodied and dislocated from the constraints of objectivation and embodied experience *simpliciter*. Ever astute, he claims that, if this is so, it is “destructive of all the conditions of experience” [2002; 293-4]. Once again, he reasons this cannot be “objectively true” because it would be “subjectively humiliating”.

Formalised and cosmological time—abstracted from all “conditions of experience”—demonstrates these “conditions” precarious and parochial. Yet, it is not outright “destructive” of them in the simplistic way presumed by Coleridge: in that it does not invalidate their continued use as organizing “rules for the exhibition of appearances” [CPR; A246-7/B303]. (As explored in Chap.3, their lack of substantive root is not a weakness but part of their functional indispensability: modally-rich ideas of ‘causality’ and ‘regularity’ are norms of inquiry—not foundational givens—that help us build ever more coherent and accurate explanatory models of physical systems precisely by giving us a motivating reason for consilience and the replacement of models of local applicability with ones of ever wider range and reliability.) Nonetheless, Coleridge was not alone in the presumption of these principles’ unqualified “destruction” given their expatriation from nature. As amply explored, catastrophism provided the most clear-cut example of this: Cuvierianism rejected substantive identity of ‘temporality’ and ‘uniformity’, yet, in so doing, jettisoned ‘uniformity’ altogether as an explanatory principle. As such, the infinite divisibility of effects into causes (i.e. the Principle of Sufficient Reason) rationally presupposed by experiential and embodied inquiry was replaced—*indeterminately and indiscriminately*—with a catastrophist time riven by irreducible scission and unaccountable hiatus. This, of course, was received—from within experiential horizons—as a marked sense of

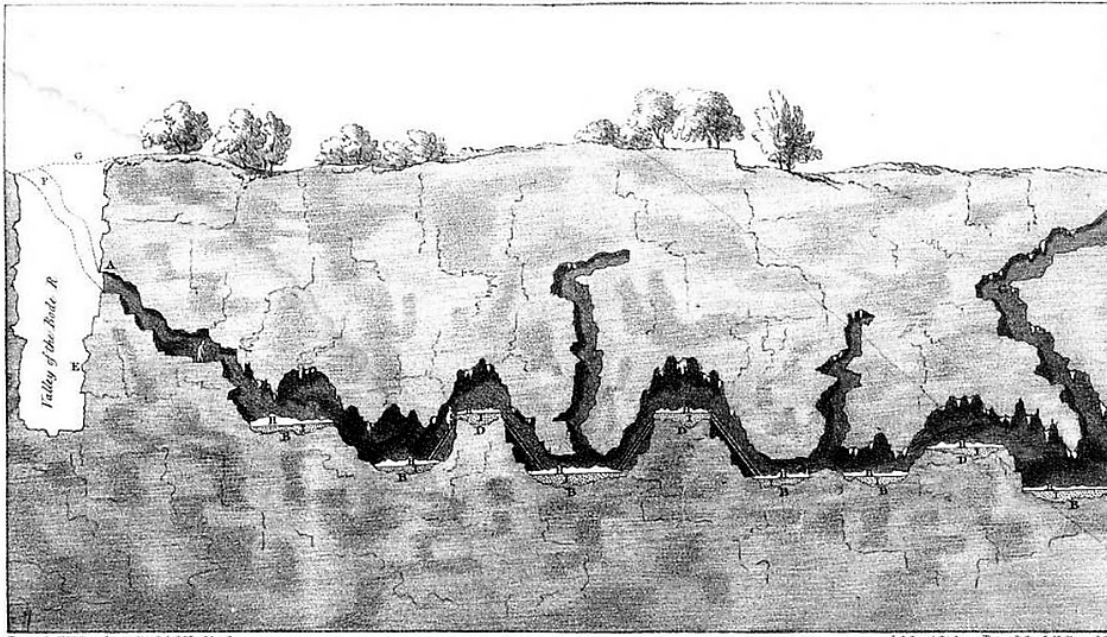
chronological disorientation and anomaly: a breakdown of scrutable temporality itself. Novalis, experimenting on analogies between history and mineralogy, spoke of “*transitus*” being a fundamental lesson from geology, whilst promoting his “oryctognostic schema” (i.e. mineralogical schema) of chronology as one that “allows us to find the *gaps*” [2007; 118, 261]. Accordingly, Schelling, speaking of “strata [superposed] one upon the other”, remarked that “the oldest formations of the earth bear such a foreign aspect that we are hardly in a position to form a concept of their time of origin or of the forces [then] operative” [1942; 11-2]. Thus, stripped of the threads and causal connective tissues that ‘body forth’ atomic events into a legible history, temporality no longer makes sense as a continuous ‘flow’ and is instead disarticulated, disaggregated, and dethreaded into the irreducible aeonic ‘schists’ insinuated by Cuvierianism.¹³

Moreover, in subtracting the presupposition of sufficient reasons, stipulations of ‘contiguity’, ‘coevality’, and ‘linearity’ were similarly eliminated. As Schelling put it, “nothing prevents [an] earlier time from migrating through later time via particular phenomena [and], conversely, nothing prevents a later time from having emerged earlier in some parts of the universe than in others” [2000; 96]. A breakdown of linearity (or, ‘horological deregulation’) suggesting *recidivist pasts* and *precocious futurities*. Of course, ever since Steno, stratigraphic depth had been legible as temporal regression,

¹³ The traditional scriptural metaphors for palaeontological matters helped play into this sense of denaturation: consistent metaphorology concerning ancestral nature’s “hieroglyphs” [Schelling, 1966; 40] readily offered themselves for repurposing to express more a sense of textual *absence* and *indeterminacy* rather than any reliable and uninterrupted tradition.

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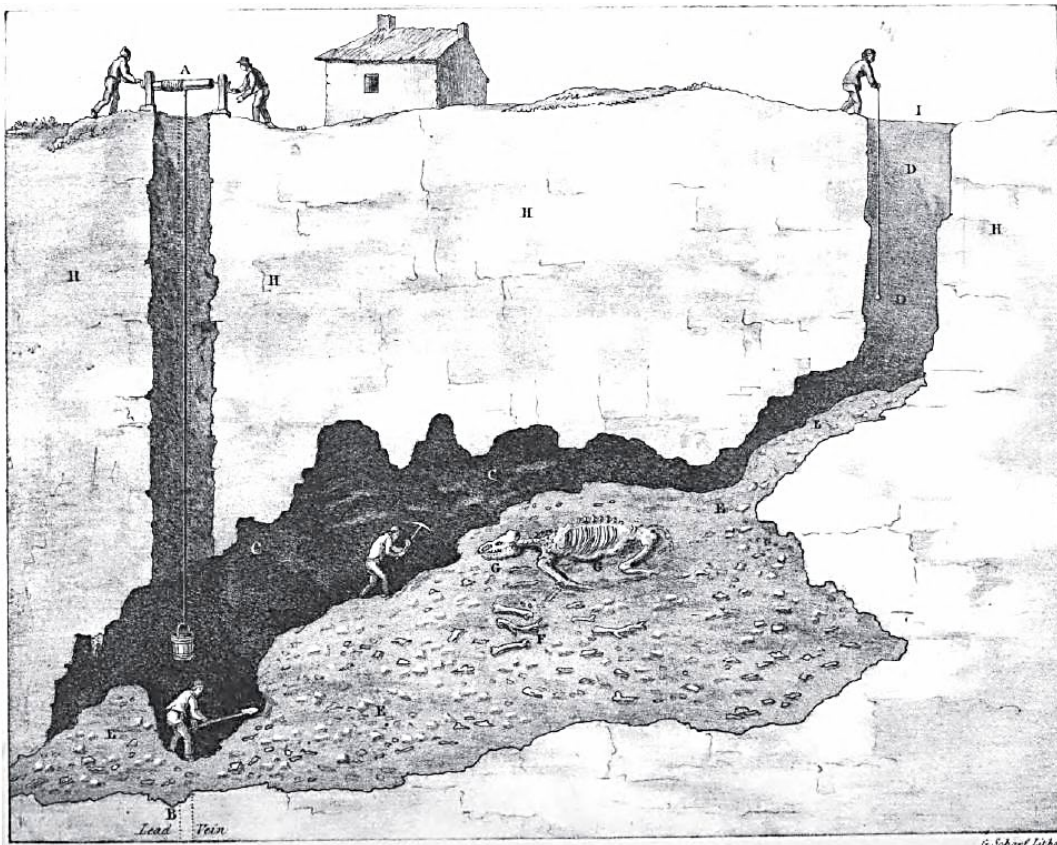
Pl. 16.



Drawn by J. Walker from a Sketch by W. Buckland.

G. Schaeff Lithog. Engraved by C. Hoffmann del.

SECTION OF THE CAVE OF BIELS HÖHLE IN THE HARTZ.



Drawn by J. Walker from a Sketch by Prof. Buckland.

G. Schaeff Lithog.

SECTION OF THE CAVE IN THE DREAM LEAD MINE NEAR WIRKSWORTH, DERBYSHIRE 1822.

Buckland's speleological cross-sections [1823]

such that descending into the earth was plainly understandable as travelling back in time. (We see this best in popular depictions of Buckland’s famous descent into Kirkdale Cave and Conybeare’s 1822 illustration of Buckland being transported back in time and finding prehistoric hyenas still thriving inside: an image igniting cultural imagination and triggering ‘cave-mania’ [Bailes, 2015; 678].) Yet, consistently and continually, plausible futures and counterfactuals were lumped, alongside concrete pasts, into subterranean spaces: Novalis’s *Heinrich von Ofterdingen* depicts, in a manner alike to MWS’s sibylline leaves, the eponymous hero discovering a strange manuscript underground, written in unknown dialects, wherein he is himself uncannily depicted in entirely alien settings and situations. Aside from the classical topos of underground prophecy, I argue that this conspicuous collocation of ‘cavernous’ and ‘counter-to-fact’ emerges due to the fact that geochronology’s utterly de-semantified time was similarly abstracted from plenitude, insofar as plenitude, too, is a mandatory functional “rule” of experience, such that, in addition to becoming symbolic topoi for the deregulation of linear time, caves likewise became symbolically charged as sites of strong counterfactuality and unrealised possibilia.

Indeed, alongside notions such as ‘causality’, Kant similarly taxonomized ‘plenitude’ as a presumption—of only “subjective necessity”—that we deploy in order schematize experiences and make sense of them [CPR; A231-57/B284-313]. (That is, presuming the matter of empirical intuition as *maximally* justifiable under schematic categories is the precise obverse of presuming that, within experience, every tangible effect has a justificatory cause: ‘plenitude’, thus, is basically the discursive norm that *makes us feel obligated* to subsume all conscious experiences under identifiable concepts.)¹⁴

¹⁴ It is thus the very heart of Kant’s theory of “schemata”.

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As early as 1770 [Hintikka & Kannisto, 1981], Kant had bracketed such ‘obligation’ for mind-independent reality; and, by his critical phase, he had cogently formulated plenitude as being amongst those “principles” that are “merely rules for the exhibition of appearances” [A246-7/B303]. Whilst Kant was careful to retain these as subjective “rules”, wider reactions to temporal disorientation were not so scrupulous. Thus, as with ‘uniformity’, commitments to substantive ‘plenitude’ were not just critically bracketed as methodological maxims but negated outright. Thus, again, leading to a sense of profound ontological anomaly, and accordingly also the topos of geological sites as places where *unrealised possibilities* and *counter-to-fact histories* are stored, alongside concrete fossilised pasts.

Revealingly, Byron’s plagiariser, J.E. Reade, prefaced his impersonation of ‘Darkness’ by pretending that its inspiration came to him from “reading some theories of the earth [whereby] it struck me, that the final of all things, as caused by earth’s aberration from her sphere, and consequent intense cold and darkness [was] fully as natural and as likely to occur, or to *have* occurred, as any other consummation” [1829; 171, original emphasis]. Once again, any clear demarcation between fact and counter-to-fact—past and future—is suspended. Byron himself had, in *Don Juan*, prospected that “this world shall be *former*, underground”:

Thrown topsy-turvy, twisted, crisped, and curled,
Baked, fried, or burnt, turned inside-out, or drowned,
Like all the worlds before, which have been hurled
First out of and then back again to Chaos
The Superstratum which will overlay us.

“Baked” and “burnt”, just like a dumpling. “So Cuvier says” [IX.291-7]. Byron concludes, channelling Hamlet:

But I am apt to grow too metaphysical:
'The time is out of joint,'

[IX.321-2]

It was precisely this 'temporal disjointing' that had allowed geodesic depth to become the library of innumerable "worlds": both previously actual *and* perpetually unrealized.

We have already traced this idea to *Cain*'s world-repository in Chap.1, where we related it to Leibniz's "*Palace of Fates*" as metaphorological source for such a storehouse of 'possible worlds'. Accordingly, this Leibnizian locus of possibilia became a heuristic for understanding geological contingency: though, of course, one that uncompromisingly transplanted 'divine choice' with 'plutonic force', and 'optimality' with 'prodigality'. It turns out, indeed, that Schopenhauer, upon reading *Cain*, was alert to this exactly this analogue. The philosopher argued of this "immortal masterpiece" that Byron ("in his serious and tragic way") cogently supplies us with a *perfect inversion* of Leibnizian theodical optimism: by way of reoccupying Leibniz's modal apparatus of 'possible worlds' so as to present an opposing vision, through revealing hypogaeic "records of worlds" and the sheer abundance of their mindless extinctions—*both actual and merely possible*—such that Schopenhauer contends that *Cain* dramatizes his own pessimistic thesis that ours is, in fact, the "*worst of all possible worlds*" [1969; ii.584-5].¹⁵

¹⁵ Identical to Sade, Schopenhauer neatly inverts plenitude, but absolutely does not escape it. He argues *Cain*'s ruined worlds provide evidence of prior creations whose "continuance was no longer possible", as they proved *even* "worse" than ours, and, thus, they became non-viable and ended [1969; ii.584]. Cunning though this is, it firmly commits Schopenhauer to plenitude. (*A plenitude of pain is a plenitude nonetheless.*) If a world must have the maximal amount of suffering, it requires eternal sufferers, such that there is no true terminality nor extinction. Indeed, despite elsewhere seemingly accepting extinctions, Schopenhauer also claimed that "in spite of thousands of years of death and decay, there is still nothing lost, no atom of matter, still less anything of the inner being exhibiting itself as nature". Thus, "death is for the species what sleep is for the individual" [1969; ii.479].

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And thus, so it was that ‘the chthonic’ came to be coded as the site of *hypothetical histories* and *counterfactual futures* as much as of petrified pasts. For, prior to Wellsian machines, the deep earth offered itself as the very first chrono-locomotive engine. It was through a wide-held—yet ultimately overblown and uncritical—reception of geoscience’s enunciation of an entirely de-semantified time that the cave-mouth’s transit from epigene to hypogene became symbolically charged as the vestibule to counterfactuality. This, therefore, is why early extinction-narratives, from Grainville to MWS, interpolate themselves within speleological enclosures. It is to the content of MWS’s narrative that we now turn.

3—THE LAST MAN

3.1—forecast

Horn [2014; 65] wrote that ‘Darkness’, as ‘anthropological stress test’, places ‘humanity in a disaster scenario just as a scientist would subject individuals to experiment’. The same applies to MWS’s *The Last Man* (hereafter ‘LM’), which, having framed its hypothetical ‘crucible’, subsequently models a similarly terminal scenario. And, just as *Cain*’s inverted theodicy shatters one breed of Enlightenment optimism, so too does *LM*’s conditional ‘what-if’ scenario: specifically, it meticulously renders invalid PBS’s own materialist soteriology, as it was instanced in *PU*.

MWS embeds “astronomical theories” and “calculations” [LM; 226] within her novel by way of the tragic character named Merrival. Prior to the novel’s depiction of human extinction via planetary pandemic, the main characters are seen discussing humanity’s long-term prospects of flourishing—unaware of impending doom. Adrian, an optimist in Shelleyan mould, recapitulates PBS’s conviction that “earth will become a Paradise” via covarying interdependences between political

emancipation and global climate. Other characters dispute this, claiming climatological accord is far off. “We shall all be underground”, petitions the sceptical Ryland; who is, of course, tragically correct.

At this point, Merrival, “the little old astronomer”, interjects:

Not so far [then] as you may suppose [as] the poles precede very slowly, but securely;
in an hundred thousand years [the] pole of the earth will coincide with the pole of
the ecliptic [and] an universal spring will be produced, and earth become a paradise.
[172]

We recognise this instantly as PBS’s dearly held theory of diminishing orbital obliquity. Closely resembling PBS’s ideas, Merrival (whose magnum opus is appropriately titled ‘Essay on the Pericyclical Motions of the Earth’s Axis’) describes his presentiment of “seasons [becoming] equal” and “air breed[ing] no disorders”, all consequent upon axial equalisation; “after the lapse of an hundred thousand years”, there will be “prospect of paradise” for humanity and, thus, the inauguration of utopia [173]. MWS, of course, embeds all this in order to plausibilistically ‘simulate’ its disconfirmation through extinctive terminus. Poor Merrival, indeed, later dies alone as the plague kills his family and ravages civilization: his speculations upon “mankind six thousand years hence” inherently meaningless, his “astronomical theories” and predictive models of “planetary motions”, now “scrawled with coal on the bare walls of his garret”, illegible forever [226-7]. (Nonetheless, even the optimistic Merrival’s prognosis was not unequivocal. Although no-one listens, he also projects an “earthly hell” subsequently occurring when “the ecliptic and equator [will] be at right angles” [173], such that seasons would swing between inhospitable cold and deadly heat, being the antithesis of the uniform summer imposed by an uninclined axis. Accordingly, the astronomer speculates upon those

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“creatures, who would then occupy the vacated dwelling of mankind” [227].)¹⁶ Thus, Merrival, whose computational and predictive outlook “pace[s] a coming eternity” with “seven league strides”, is seen to stand upon “the precipice of time” [269]. Inevitably, he, along with the rest of his species, falls in.

MWS, implicitly vying against the naïve utopianism of her husband, was writing from the perspective of the latter 1820s. Certainly, in the ensuing interval, evidence of extinction had only multiplied. By 1800, Cuvier named 23 confirmed fossil species [2008; 53]; a reconstructed Mastodon had been toured throughout Europe by American entrepreneurs [Peale, 1803]; remains of creatures such as *Megalonyx* and *Mosasaurus* had been uncovered; and, moreover, increasingly many popular articles had been divulged on the topic [anon., 1800]. The Cuvierian view of multitudinous extinction-events had, by the 1810s, become scientific orthodoxy: Blumenbach, in 1806, confidently opined that nature “will not go to pieces if one species [entirely] dies out” and, more so, that this frequently takes place “without the slightest danger” to either the “physical [or] moral world”. He declared that every paving stone in Göttingen as compacted with “proof” of “whole genera” extinguished [Lauden, 1987; 148]. Mid-1810s, Schelling described nature as nurturing species to “their pinnacle” before “bury[ing] them in oblivion”, without remorse [2000; 21]. To add to this, we note that, after 1816, underneath Tambora’s incarnadine skies, carmine sun, and grave geopolitical ramifications, nature was given a positively turbulent aspect. During the 1820s, thanks to efforts of British catastrophists from Mantell to Buckland (the latter entering his infamous hyena cave the year before PBS’s passing), first awareness of *Dinosauria* took hold. Significantly, Sunstein relates that

¹⁶ As explored, Fourier had already reached similar theories. MWS cites Sampson Arnold Mackey as source. Mackey [1822-3] had conceived of long-range axial cycles causative of climatic pendulum-swings between a “Golden Age” and a baneful “age of horror”.

MWS, by 1828, had become friends with prominent Silurian geologist Roderick Murchinson: the same year, MWS proposed to her publisher a ‘book on geology and prehistoric archaeology’; intriguingly, she warns her prospective “History of the Earth”, which would sketch “ante-diluvian remains”, may encroach “upon *orthodoxy*” [Sunstein, 1991; 307-8]. She had, however, already done exactly that, regarding our *own* extinction, in her previous novel.

3.2–catastrophe

MWS’s choice of plague as kill-mechanism in *LM* might seem profoundly removed from geophysical researches. This is not entirely true, however. We have already seen Merrival connecting airborne “disorders” to seasonal disparities, which, in turn, depend upon earth’s orbit. This was an etiological concatenation traceable back into antiquity. Passing from Hippocrates to Aristotle, and from Galen to Avicenna, long-running miasmatic theories of nosology had attached ‘diseased air’ to chthonic exhalations [Bergman, 2013]: Lucretius spoke of “pestilence” as effluence “from the earth itself”, whilst simultaneously keying this into how the Earth’s “axis pivots” [2007; 231-2]. Centuries later, *Paradise Lost* connected our post-lapsarian planet’s shunted “axle” to its “pestilent” outbreaks [X.668-95]; yet later, Dr Arbuthnot wrote of disease-inducing “mineral exhalations of the ground” [1751; 207]; Kant, similarly, had speculated upon a causal connectivity between “subterranean” forces and the “air that renders some illnesses [...] *epidemic*” [Fenves, 2003; 141]; in identical vein, Schopenhauer went on to connect “powerful” hypogene forces to “cholera, yellow fever, [and] black death” decimating “millions” [1969; ii.583]. Miasmatic theories, indeed, survived well into the cholera pandemic triggered by Tambora’s fallout [Wood, 2014].

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Plague was considered keyed into planetary dynamics as much as seismic or volcanic shocks. Appropriately, then, MWS deploys plenty of catastrophist and Cuvierian metaphors when describing plague's progress in her novel. The disease's "vast annihilation" is described "rising from [a] subterranean vault" [209-13]. Hence, why MWS describes the "swift-approaching end of things" [258] as a "cataract of destruction": it was, her characters report, as if a "gulph yawned, into which we must of force be precipitated" [243-4]. The spreading disease, moreover, is itself coeval with freak meteorological events that, it is said, appeared to be "mocking the usual laws of nature" [211]. Cuvier looms in the background here. "Some disorder had surely crept into [the] elements, destroying their benignant influence" [180] with "whole countries [laid] waste, whole nations annihilated" [184]: it is as if "an earthquake had changed the scene—under our very feet the earth yawned—deep and precipitous the gulph below opened to receive us, while the hours charioted us towards the chasm" [214]. "Nature, our mother, and our friend, had turned on us a brow of menace", such that

She shewed us plainly, that, though she permitted us to assign her laws and subdue her apparent powers, yet, if she put forth but a finger, we must quake. She could take our globe, fringed with mountains, girded by the atmosphere, containing the condition of our being [and] cast it into space, where life would be drunk up, and man and all his efforts forever annihilated.

[183]

One notices resemblance to Mercier and Byron's own visions of deorbiting: indeed, inhabiting the physicist's language of computation, it is metaphorically pictured that "with excentric wheel [the earth] rushed into an untried path" [241]. Such catastrophist episodes climax, indeed, with delineation of a "sun of darkness" that "eclipsed the bright parent of day". A "black sun", that is, which is recorded as rising over the northern hemisphere and bathing it in darkness—notably, *just* as the plague beings its spread. Widely reported across nations as an "orb, the size of the [sun], but

dark [and] whose beams were shadows”, this *sol niger*—a physical incarnation of Byronic ‘Darkness’—casts blinding tenebrosity upon the planet: “[n]ight fell upon every country, night, sudden, rayless, entire” [176-7].

The episode is left utterly unexplained and unexplainable. Moreover, it is not allowed to accrue any significance of the kind that would categorise it as revelatory or apocalyptically meaningful. It, instead, seems utterly meaningless. This is notable because the tacit norms of the text’s chronotope are, elsewhere, encompassing in their naturalism—and, thus, are neither fantastical nor supernatural—yet, just as there is no resolution of this “object of fear” into the marvellous or miraculous, neither is there any hint of its nomic accountability, such that, given this conspicuous absence, the event can plausibly be read as a kind of catastrophist rupture, along the lines of the irreducibly unaccountable and singular (yet entirely secular) events that Cuvier proposed as riddling terrestrial history.¹⁷

And yet, wouldn’t this commit MWS to the specious—and, ultimately, anti-realist—presumption that the ‘end of mind’ drastically affects the rest of nature? Seemingly, it would. And yet, the novel’s major innovation above its forerunners is its dedication to the opposing view. Throughout the rest of the novel, that is, MWS wields a powerful coupling of ‘*semantic catastrophe*’ and ‘*ontic uniformity*’ in order to achieve the radical ‘mind independence’ demanded by mature representation of our extinction.

¹⁷ An analogue is an episode in Grainville wherein the moon destroys itself [1806; i.101-2].

3.3–uniformity

LM's third volume, wherein the final moments of human history unfold, opens with a list of apocalyptic world-movements, in catastrophist mode: from “thunderbolt” to “coming tempest”, to “destruction lurid and dire pour[ing] down on the blasted earth”—“all announcing the last days of man”. This litany ultimately implodes into chilling bathos, however:

No! none of these things accompanied our fall!

MWS goes on to report that, instead of cataclysmic georevolution, there was merely “balmy air of spring” suffusing the “lovely earth”: “nature’s ambrosial home” [249]. Here is the novel’s major innovation: the severing of coevality *apropos* nature and mankind’s respective termini.

Even Byron’s ‘Darkness’, that is, had depicted *concurrent* death for humanity and the rest of our biosphere; *LM*, contrastingly, abounds in depictions of nature’s *post festum* uniformity and, specifically, abundance. For, overriding the novel’s prior implications and insinuations of catastrophic “eccentricity”, there is actually, in the event itself, “no change—no ruin—no rent made in [earth’s] verdurous expanse”:

she continues to wheel round and round, with alternate night and day,
through the sky, though man is not her adorer or inhabitant.

[357].

(This innovation did not go unnoticed by nineteenth century critics. Eugen Kölbing [1896; ii.212], philologist and editor of Byron, looked back from the 1890s on the “*letzten Menschen*” topos and commended “Mrs Shelley” for “deviating completely from her predecessors”; for, where Byronic terminus is “conceived as synchronous with the extinction of the sun [and] associated end of the

world, so here is there no change mentioned in the course of nature” and only “the human being is eradicated”.)

Of integral importance concerning this innovation is the thematic doublet, conspicuously operative within *LM*, of ‘*ontic uniformity*’ and ‘*semantic catastrophism*’. We elucidate the meaning of this by way of mapping it onto the parallel Kantian coupling of ‘empirical realism’ and ‘transcendental idealism’ (the conceptual kernel of Kant’s anti-foundationalism) as referring to critical philosophy’s core contention that the content of our sense-experience of natural realities is mediated, necessarily and inextricably, by irreducibly non-natural (because ultimately semantic and normative) features of our cognitive framework. This facilitated coherent wedding of object-level ‘realism’ with semantic ‘ideality’: exposing the fact that key features *enabling* our experience of independent nature are nonetheless themselves irremediably *non-natural*, thus disentangling independent existence from its semantic mediations, which, in turn, first enabled ‘human extinction’ to become fully articulable as a ‘disaster’ *exclusively* of semantic scope—a ‘catastrophe’ within the sphere of values and reasons alone—that, thereby, does not at all affect or molest the continuance of wider nature’s object-level operations. And so, this, identically, is how MWS can so consistently marry the imagery of irreversible paroxysm (‘semantic catastrophism’) with nature’s unaffected uniformity after our departure (‘ontic uniformity’). For extinction is, in dimensions of value and meaning, a cataclysm of utterly absolute proportions; yet, since semantic and value-laden concerns do not at all extend into factitious nature, the rest of reality cares not one bit for this casualty.¹⁸

¹⁸ Whether MWS directly knew Kant is largely irrelevant. Kant’s vast achievement was in cohering and explicating wider intellectual tendencies. Nonetheless, Roberts [1997; 89] persuasively contends

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Our extinction is specifiable as a ‘disaster’ solely because to be human is to know how to *correctly* apply words such as ‘disaster’ and, accordingly, our existence is inextricably value-laden and is, as an unavoidable symptom of this, *valuable*.

It is because of the necessitous ensconcing of all objective assertion within a framework of normative appraisal that “[human] minds embrace infinity” (in the sense of scientific truths of astrophysical extent) yet this grand knowhow is simultaneously localised *entirely* to within the “visible mechanism of our being [which] is subject to merest accident” [181] (in the sense that ‘knowing that’ makes no sense outside of the value-laden discursive game—played, exclusively, by concept-mongering animals—that alone tokens such ‘knowings’ as *worthy*). This is why Lionel (the protagonist and eponymous ‘last man’) can weep, when he is left as the sole concept-using animal, that he “alone could give articulation to thought” [350]. Yet, because of the inseparability of ‘objective assertion’ and ‘normative appraisal’, there is a sense in which cognitive activities are necessarily *recognitive* activities, in the sense of being mediated by the wider *community* of discursive practitioners or concept-users [Brandom, 2009]. In the novel, it is highlighted that ‘meaning’ is inextricably bound up in community, by way of carefully staging the collapse of our normal attitude toward death as being mitigated and made significant by social “posterity” (i.e. we arrogate “that though the individual is destroyed, man continues for ever” and—thus “learn[ing] to regard death without terror”—we “glory in the continuity of our species” [182]).¹⁹ This clearly demonstrates that private cognition is tied up in public recognitive mutuality, such that, when Lionel is left “alone”, and

PBS’s readings in German philosophy have been underestimated; whilst Volkova [2014] argues for direct Kantian influences within MWS’s *Last Man*.

¹⁹ MWS pointedly quotes Burke’s [2003; 29] dogmatic faith in indefinite posterity.

“[p]osterity is no more”, “fame, and ambition, and love, are words void of meaning” [255]. As such, MWS cogently draws out the paradoxical placement of Lionel: for the ‘last person’ can, properly speaking, be ‘no person’ at all; for, bereft of social *recognition*, he is ‘already extinct’; and not merely ‘reproductively’ but, also, ‘discursively’ so. “The world was not dead, but I was mad”, admits Lionel, acknowledging his paradoxical position as terminarch.

In thus coupling ‘semantic catastrophism’ with ‘ontic uniformity’—and extracting ‘value’ from ‘fact’—MWS stages a *reductio* of plenitudinarian presumption. For, as population dwindles, “piles of food” begin to gather in “useless superfluity”. There is, throughout, wicked juxtaposition between dying humanity and nature’s perpetual “fertile beauty”. Unaccompanied by “earthquake” or “blasted earth”, extinction is instead “companion of spring, of sunshine, and plenty”. “Look at England!”, Lionel exclaims, “the grass shoots up high in the meadows”, whilst multitudes perish amongst “unreaped corn stand[ing] in barren plenty” [250-5]. This, indeed, is the realisation of Milton’s fear of “*waste fertility*”. Eventually the “corn that sprung in plenty, [lay] rotting on the ground” and

green woods waved their boughs majestically, while the dying were spread
beneath their shade, [and] the careless dear reposed unhurt upon the fern—[whilst]
oxen and the horses [grazed] among the wheat, for death fell upon man alone.
[216]

Abundance without reason is gross exorbitance and cruel indifference. Whilst “the ominous voice [of extinction] breathed up with pestiferous vapours from fear’s dim cavern”, nature was “laughing and scattering [...] flowers, and fruits, and sparkling waters” [215]: perfectly encapsulating the powerful conjuncture of ‘semantic catastrophe’ and ‘ontic uniformity’.

Lie down, O man, on the flower-strown earth;

[250]

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Nature, more like Medea than Gaia, “was the same, as when she was the kind mother of the human race; now, childless and forlorn, her fertility was a mockery; her loveliness a mask for deformity” [260]. Yet, overstepping those like Sade and Schopenhauer, MWS’s novel coherently acknowledges that nature’s lack of judiciary itself warrants *no* judicial orientation or injunction (to libertinage or pessimism, for example). It just simply *is*. With this, all umbilical or amniotic containment (even of the inverted kind) is revoked, and value-laden cognition is congruently expatriated from verdant nature (whilst any backdoor attempts at repatriation—via Schellingian hypostatization of some geocosmic unconscious—likewise become foreclosed). No longer Wordsworth’s “Dwellers of the Dwelling”, the “dwellers were gathered to the shades of the tomb”:

—we feared the cloudless sky, the flower-covered earth, and delightful woods, for
we looked on the fabric of the universe no longer as our dwelling, but our tomb,
[250]

The cosmos, as Richter’s Dead Christ announced, *was never our womb*. Lionel, now “monarch of the waste” [349], is cognizant of this revocation of rationality’s once-presumed metaphysical patrimony: humanity’s “tenure of life insecure”; our “inheritance on earth cut off” [182].

3.4—deracination

Oncoming extinction reveals to Lionel that the human “soul, islanded in the world, [is] a solitary point, surrounded by vacuum” [350]. Kant, too, had intoned that reason “is an island”: where (no longer contained umbilically within a vital and noetic universe) mind instead becomes an archipelago surrounded by “a wide and stormy ocean” [CPR; A235/B294-5]. *LM* extends this intuition by reworking metaphors casting *Geist* as an unmoored ship.

MWS recurrently refers to society, that is, as a “vast and well-manned vessel” [7]—instituted to protect citizens from “eruptions of nature” [183]—and yet it is now reduced to a “shattered raft”, comprehensively “wrecked” [253]. Having once “mastered the winds and rode proudly over the waves” [7], civilization’s vessel is “riven and tempest-tost” [253]. The death of nations is lamented in similarly metaphoric terms. Namely, as a kind of tectonic uprooting:

Alas, what will become of [England]? It seems as if the giant waves of the ocean, the vast arms of the sea, were about to wrench the deep-rooted island from its centre; and cast it, a ruin and a wreck, upon the fields of the Atlantic.

[181]

Thirty-six years prior, Burke had used identical images of national ungrounding: he did so, however, with the intent of communicating the effects of emancipatory reason and its symptom, *global revolution*. Occupying a catastrophist register, Burke imagined revolutionary reason as a force that will break “up the foundations of the great deep to overwhelm us” [2003; 49], thus communicating rationality’s tendency to upturn institutions rooted deep in national soil (for Burke, ‘land’ is one of the preeminent ways that societies ‘remember’) [2003; 133]. Thus, Burke, looking across the channel, saw enlightenment—imagined as “a hollow murmuring underground”—as already destabilizing ancient national ground, leaving a rootless France to be “blown about, like the light fragments of a wreck” [2003; 132, 162].²⁰ Post-revolutionary cadastral, he warned, had gone toward undermining and erasing “every land-mark” due to its “geometrical and arithmetical” apriority [2003; 46]. Reason is described as an “under-ground [force] that will blow up, at one grand explosion, all examples of antiquity” [2003; 49]. Here, ‘the Universal’ indexes undeniable potency: the purity of the *a priori* is

²⁰ This probably derives from Thomas Burnet’s [1964; 105] georevolutionary vision of “ragged Islands” and entire “Countries pull’d up by the roots, and planted in the Sea”.

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here cast not as ineffectuality or impalpability but as a formidable—yet annihilating—world-historical force. *Reason deracinates*, Burke noticed. The ‘ideal map’ rewrites the ‘tangible territory’: liquidating lived realities like an “earthquake” [2003; 132].

MWS, accordingly, reprises Burke’s imagery, but does so antagonistically: inhabiting his metaphoric apparatus of ‘*national ungrounding*’ but doing so only in order to perform thought-experimental *reductio* upon Burke’s dogmatic faith in tradition’s solid foundation (i.e. his unwavering faith in “national institutions [that have] cast their roots wide and deep” [2003; 133]), and she accomplishes this via representing its *total ungrounding* through inconsolable extinction. In expropriating Burke’s metaphoric organ, however, MWS inevitably reveals a symmetry between the global symptomatology of plague and of reason itself.

Both reason and extinction are, identically, uprooting. In order to represent this successfully at scale—which is indispensable to the novel’s achievement of its full force—the globe itself becomes the locus of narrative focalisation.

3.5—multiscalarity

The Last Man is truly global. Cantor goes so far as to claim that ‘it is one of the first works of imaginative literature to take the entire earth as its stage’ [1997; 195]. Though the immediate action never leaves the continent, there are incessant reports from across global space: from “Delhi” [176]; from the “vast cities of America” [184]; from “Quito” [183]; from the “crowded cities of China” [177]. The novel opens, tellingly, with a meditation upon England’s position within this world-spanning stage.

Globalism—referring to interconnected material conditions of ‘time-space compression’ as much as to a special type of self-conception—is a long-term process beginning with a ‘germinal phase’ in the fifteenth century before entering its ‘incipient’ stage from 1750-1875 (following consolidation of recognizably modern nation states, along with attendant international relations, and cross-border communications, etc.) [Robertson, 1992]. In its *long durée*, it was originally triggered by early modern advances in mapmaking and circumnavigation (Columbus, 1492), cosmography (Copernicus, 1543), and standardizations of timekeeping (the Gregorian calendar, 1582), alongside relentless rises in press volume and circulation, facilitating communication networks of increasing density and scope—all downwind of the catallactic networking of global markets and reticulating trade relations, congruent upon emerging imperial and expansionist interests (exemplified by Westphalian sovereignty and New World colonialism, respectively), progressively crosshatching the planetary surface. Given the definitive ‘emergence of [a] global economy in the early nineteenth-century’, this makes the ‘Romantic period an important era [for] globalization’ [Casaliggi, 2016; 71]: aside from exhaustive exploration (from Cook’s Pacific voyages to encroachments towards the poles), the period saw ‘increased mobility of commodities and ideas, the unprecedented expansion of global trade, improved navigational techniques, and cultural and racial mixing’, Nussbaum records [2003; 8]. More distinctly, the period of ≈1750-1850 sees an important threshold concerning globalization’s long-durational process in *the emergence of an increasingly identifiable lexical self-awareness of globalism itself* (epitomized in the emergence of fields like recognizably ‘modern geography’—à la Ritter, Herder, or Humboldt—which began articulating ‘human engagement with the structures and processes of terrestrial space’ [Tang, 2008; 21]). A ‘planetary consciousness [...] blanketing the

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surface of the globe’ was precipitated [Pratt, 2007; 37]. In other words, globalism had become self-reflecting. And, indeed, from a certain perspective, globalization *just is* self-consciousness of globalization: for, *as soon as one operates under a universal horizon, one cannot but be universalizing in one’s actions*. We recount this because it is this self-reinforcing and self-causing tendency that makes world-oriented rationality look a lot like a pandemic (and, hence, why, as formidable force, Burke used catastrophist imagery to diagnose it). Indeed, the ‘infection vector’ that MWS mobilizes to elicit this analogy in *LM* is the very material embodiment of ‘world-consciousness’ itself: the global communication network, or, the news.

3.6–nosological globalism

According to Cantor [1997; 195], what is ‘strikingly modern’ in MWS’s novel is the way ‘in which events that happen in remote corners of the planet have almost immediate and wholly disastrous consequences halfway around the globe’. From the “sunny clime of Persia” [177] to “fertile plains of Hindostan” [184], it would not be exaggerative to say that the narrative progression is metered entirely by dispatches and deliverances, of plague’s progress, from far off places. “Quito was destroyed by an earthquake”, we learn; “Mexico”, too, “was laid waste by united effects of storm, pestilence, and famine” [183]; “America has also received the taint”; and the infection of Greece, we learn, “had been preceded and caused by contagion from the East” [175]. This incoming bulletin of death nurtures a very modern and realistic sense of “a scale of fearful magnitude” [175], making MWS’s creeping extinction far more plausible (and thus effective as a thought-experimental ‘stress test’).

This sense of planetary-scale optic is achieved via the narrative focus’s inhabitation of a newly confluent global news-consciousness. For, just like telescopes for a prior generation, the technics of

emerging news networks (and attending time-space compression) enabled an entirely novel aperture and perspective upon our world: just as Swift utilized the microscope as ocular frame-device in *Gulliver's Travels*—and as we have today begun to intuitively 'see' like satellites [Rothe, 2017]—the eighteenth century's nascent global news network provided a new planetary-scale 'sensorium', concordantly opening up new opportunities of perspectival focalization. The news, in other words, serves as the sensorium of *LM*'s chronotope. For, though properly focalized upon Lionel—via unbroken first-person perspective—the novel engenders 'vertical' scalability across focal layers, and allows telescoping across these perspectival layers, through simultaneously occupying national and global news networks as additional focal levels. Ventriloquizing the public sphere, the nation's discussion is relayed:

Where was the plague? "Here—everywhere!" one voice of horror and dismay
exclaimed,

[215]

As rhetorical device, this emulates the way individual subjects increasingly internalize the mediating voice and address of news institutions: the novel achieves the multiscalar perspective that *defines* modern subjectivity. That is, MWS embeds the reality that mediation by and through inextricably non-local contexts is a predicament that characterizes the internal horizons of all modern, world-oriented subjects—caught up, as they happen to be (whether they like it or not), in a planetary web of involvements. Through this 'multiscalarity', therefore, MWS's chronotope re-enacts the fact that all citizens are, somehow or other, *globally focalized* in the 'modern' era (via the massively-distributed 'sensorium' of what Goethe famously hailed as "*Weltliteratur*"; a new arena of text-based interchange that, as Carlyle noted, "permeate[s] the whole habitable globe" [2008; 69]).

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MWS was writing the decade prior to the serial cluster of revolutions to communications infrastructure characterized by telegraphy, rapid expansion of railroads, establishment of the first commercial media empires (e.g. Hava, Reuters, Wolff) and, thus, the birth of ‘modern journalism’. *Nevertheless*, despite being still constricted to wind-power and horse-power—to ship and stagecoach—there was, during the last decades of the eighteenth century, already a veritable ‘global circulation of texts’ [Trumpener, 2015; 224]. (Blanning [2002; 127] notes ‘the great leap made by the railways in the middle of the nineteenth century has obscured the significant progress made much earlier’.) Assembling throughout the previous century—due to improvements in literacy, road networks, postal services and horsepower—transnational news was already consolidating an ‘emergent global imaginary’ [Gottlieb, 2014; 3].²¹ *LM* is cogent of such dynamics, talking of deadly

²¹ The year 1710 had seen the founding of the General Post Office in London. Ellison [2006], locating this early eighteenth century period as a ‘critical’ crossroads ‘in the history of global systematized communication’, traces an attendant ‘information overload’ *already* within early 1700s culture. News exploded: from one regular newspaper, established in 1702, there were, by 1811, *fifty-two* regular papers in London. In 1764, newspaper volume was at 1,090,289 copies; by 1790, this had expanded into 4,650,000 copies [Rantanen, 2009; 28]. Flowing forward from early-century ‘coffeehouse culture’, news circulation and literacy boomed. Information had become resource; and supply and demand mutually catalyzed each other. This is the setting, of course, for the inauguration of Habermas’s ‘*public sphere*’. An acceleration of ‘physical communication’ implicating ‘[a]ll literate people’, by way of ‘the simple expedient of writing letters’, emergent due to an ‘improved postal service’: ‘[r]ight across Europe, mail was moved more quickly, more often, more reliably, and more cheaply’ [Blanning, 2002; 130]. Moreover, due to transatlantic ‘Anglosphere’ connections (exemplified by Thomas Paine or William Cobbett) combined with voracious appetite for updates from Revolutionary France, news became properly transnational and transcontinental. (Lukács [1983; 23] claimed the Revolution ‘for the first time made history a *mass experience*’, but it was only these prior developments that allowed it to be so.) Keeping up with demand, the steam-powered cylinder press was implemented by *The London Times* in 1814 (using a mechanism based on principles of projection essentially identical to those that had originally facilitated Mercator’s globalizing world-map). Thus, as Maria Edgeworth [1971; 303] wrote to Walter Scott in 1821, “[thanks to] the mail coach and the steam packet [we] can all see and hear what each other are doing and do and read the same things nearly at the same time”.

dispatches spreading “through the various channels of commerce”: of news flowing through circuits of “[t]rade” and through the “interchange of cargoes between us, and America, India, Egypt, and Greece” [184].

Consequently, in the novel, the pandemic’s spread re-traces the *very same* globalizing course that news had taken across previous decades (and, by extension, also the catallactic markets that these communication networks piggybacked upon). Both are, inherently, ‘universalizing’ in that *their spread facilitates their further spread*. “[T]here is no refuge on earth”, a defeated Ryland mourns, “all the world has the plague!” [191]. News and plague come to analogize each other insofar as both are self-reinforcing dynamics tending towards planetary saturation: both are ‘pandemic’ in that their furtherance is self-catalysing. The novel incarnates and enacts this analogism insofar as, regarding news and plague, the medium (news) becomes the message (plague): for, as Cantor [1997; 195] notes, ‘Shelley presents the plague as a *modern* phenomenon [for] only in the conditions of the modern world could the plague take the universally destructive course it does’; or, in other words, interconnected communications networks report the progress of pestilence whilst *enabling* its further progression; such that *the bad news generates itself*, and so too does the pox, in a helix of mutual advance. Plague and news are teleologically convergent: *what is the news? the plague is the news, and the news is the plague*. (One is reminded, particularly, of an episode in which trans-oceanic shipping—otherwise the channel for much cross-country connectivity—becomes instead conduit of intercontinental contagion: an American ship, with entirely deceased crew, drifts into Portsmouth, marking the ‘initial moment of contact with plague on English soil’ [Grinnell, 2010; 106].) Globalism

becomes a type of infection, insofar as infections, in the modern world-system, become inherently globalizing.

In thus inhabiting news networks as its vector of transmission, MWS's plague comes to resemble universalizing reason itself (insofar as news-consciousness is *material organon* for rationality's assembling self-awareness and self-definition of itself as 'global commune'). Universalist reason is like a pandemic in that once you let it 'out of the box' there is *no going back*: rationality, by its very nature, is absolutizing—and it cannot help but spread—because it operates under the remit of definitively non-local and non-localizable criteria. As Carlyle notes numerous throughout *Sartor Resartus*, rationality leads, inexorably, from "WHERE" and "WHEN" to "EVERYWHERE" and "FOREVER" [2008; 43]. To operate 'rationally', that is, is to reject the expediencies of any merely 'local' authorities (sense-data, arbitrary tradition, given institutions, parochial custom, national soil) and function instead in accordance with properly 'global' criteria of correctness (submitting to reason's ultimacy—and its maxim of universalizability—as the sole supreme court of appeal, whilst submitting all assertional content to restless critique). This is why reason (as Burke feared) is inexorably deracinating (and why, as Husserl [1970; 49] later bemoaned, it is estranging and eliminative *vis-à-vis* our 'everyday lifeworld').²² And, what's more, becoming disembedded from

²² 'Human beings purchase the increase in their power with estrangement from that over which it is exerted', Adorno & Horkheimer noted [2002; 6]. Again, naturalization is second-order artificialization. A prime example being currency's 'doctrine of equivalence': the price for entering the market that supplies everything under the sun is acceptance that everything under the sun become money. Mumford noted that the clock extends this fungibility to time itself. *One conquers time by artificializing it*. A proximal example is the history of mapmaking. Prior to Mercator's celebrated world-map, the major mapping devices in use were Portolan charts, which were based solely upon aggregation of the empirical reports of sailors. Mercator, however, took the *opposite* route. (In order to solve the discrepancy between Euclidean map-space and curved planetary-space: as meridians need

parochial horizons—which is *ipso facto* indistinct from bootstrapping towards the universal—is essentially irreversible and autocatalytic: in material terms, the more international interchange there is, the more international interchange there will be (as subjects become inaugurated into ever more delocalized and cosmopolitan spheres of exchange). To think and utter the universal, then, is to be infected by it and, inevitably, to infect others in turn. This is the “Zweck” (or ‘goal’) that Fichte diagnosed as reason’s essential core. It, categorically and imperatively, *must* operate like this. Reason, then, *simply is* its globalization. Or, globalism ‘made itself’—ratcheting across terrestrial space—through its very act of self-conceptualization. It is, one could say, *essentially* pandemic (colonial history demonstrates this in an, unfortunately, horrific and tragic fashion). This, indeed, is precisely how Fichte defined mankind’s “Bestimmung”. For, once enlightened, free states are *compelled* to “transform everyone around them into free states as well, and [to] disseminate [*verbeiten*] culture to

to be parallel on a usable navigational map, where they, of course, converge at the poles on Earth’s terrestrial sphere.) The Flemish cartographer’s breakthrough—and the success of his innovative projection method—lay in an insistence upon the *internal logic of the map* (instigating an ‘artificial’ criterion of coherence) *over and above the authority of the territory* (and its merely local accuracies): ‘the spherical earth had to conform to the page-like map, and not vice versa’ [Reeves, 1993; 54]. *The rational map erases the tangible territory*. Symmetrical logic is identifiable in John ‘Longitude’ Harrison’s breakthrough with his *H5* maritime chronometer, the success of which lay in ‘the greatest independence of his system of measurement from all other spatial influences’ [Müller-Sievers, 2000; 55-6] and its instatement of an utterly fabricated prime meridian. The material globe, that is, became tractable—and webbed in concrete power networks—only by being increasingly ‘substituted’ by an ideal lattice of graticules, rhumbs and meridians. *A world become theory*. Rational science is practically empowering to the very extent that it supplants all things ‘natural’ with the increasingly ‘artefactual’. From Carlyle to Husserl, this has been regarded with reactionary suspicion. Yet, again, to reject knowledge as ‘too risky’ only provides ‘security’ in the sense that ignorance of risks does. *Science de-naturalises ‘the natural’, in that it shows that our experience of nature was always already artefactual, and, inevitably, it thereby elaborates the whole of experience as itself exposed to total risk.*

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savages and freedom to slave peoples in its vicinity”. Arcing across the planet, this instigates runaway spread:

And so, once a few truly free states have come to be, the domain of culture and freedom, and with its universal peace, will gradually encompass the whole earth.

“[Y]ou will undoubtedly find”, Fichte continues, that rationality’s “concentrations” have “expanded outward from their centres, and taken hold of one individual after another and one nation after another, and that this further expansion of culture is continuing before our eyes” [1987; 86-8].

Saturation is imperative; reason is contagious.²³ Should it be any surprise that there is a connection between the first articulations of philosophical universality and those of global extinction?

3.7–bestimmung

Throughout this thesis we have been tracing the filiation of risk and reason, in the sense that emerging from the immurement of all circumspect foundations (whether based in scriptural traditions or sense intuitions) empowers ‘the human’ in exact step with ever further immersing it in a field of cosmic risk. Yet there is a way in which this enlightening project doesn’t just reveal an environing backdrop of *pre-existent threats* but actively generates *novel ones* as part of its inner-working. Hence, why the ‘plague’+‘reason’ symmetry is more than just vague analogism: MWS’s

²³ MWS does not fail to highlight this: invoking structural reciprocity between ‘cosmopolitan universalism’ and ‘global extinction’ (via their mutually absolute closure of global space) as her characters, having abandoned filiation to deceased nation-states, exclaim “the world is our country now” [257]. A cosmopolitics, therefore, consummated only in universal extermination: for, when one is citizen of everywhere, one is citizen of nowhere, and ‘nowhere’ can be interpreted as elimination. Extinction, then, is fatally exchangeable with cosmopolitan universalism as both manifesting the “universal peace” that Fichte foresaw “gradually encompass[ing] the whole earth” [1987; 88]. Again, as Kant darkly saw, “perpetual peace” may only be accomplished in extinction’s vast silence.

plague demonstrates early sensitivity to the fact that some catastrophic risks are tied together, as potential hazards, with the *very* conditions that make us able to be *aware* of such risks.

Most fundamentally, *connectivity is also exposure*. For, to become involved in increasingly non-local contexts is to become increasingly exposed to distant risks of increasingly non-localizable scale. Global-scale interchange *ipso facto* entails global-scale precarities. A prime example is ‘plague’ itself: it is the very avenues of globalization that *enable* pandemic; for, without transcontinental exchanges, such outbreak would be strictly impossible.

Thus, precarity is not eliminated by globalizing, it is merely escalated; or, planetary rationalization does not simplistically eliminate risk, but generates novel and ever more encompassing risks as an endogenous by-product. MWS’s *LM* models this, at impressive scale, by playing on the synonymy of rationalization and pandemic. Certainly, the novel begins, uchronically, depicting the close of the twenty-first century as an age of unparalleled improvement in “[t]he physical state of man” via “the discoveries of science” [82]. The first volume is riddled with talk of theories of “the perfect system of government” [74] facilitated by utopian “machines [to] supply every want” and the impending prospect of poverty “abolished” [82]. Thus, the ensuing collapse, maturely presents ‘rationalization’ and ‘riskiness’ as dialectically entangled rather than simplistically opposed.

MWS’s *LM* models this complicity—whereby becoming ‘global’ only breeds yet more globalized forms of risk—in order to disconfirm, via thought-experimental *reductio*, the naïve optimism endorsed by her husband (and, as we see below, those like Fichte). PBS’s Prometheanism was, as we have seen, ultimately neutered by its backsliding desire for circumspect and inviolable foundations; itself premised upon the foundationalist presumption that ‘true knowing’ is classified by total

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infallibility and comprehensive insulation from infirmity. We have variously explored how true rationality is, in utter contradistinction, characterized by unceasing course-correction, rejection of foundations, and the ‘globalization of critique’: whereby infirmity is not expunged from belief, but is acceded as the very medium of making and staking better beliefs. Thus, *in attempting to have a ‘rationality’ without ‘risk’, PBS ended up outlining no rationality at all.* MWS, contrarily, embeds this naïve vision of perfect insulation in her novel—with characters credulously asserting that “the mechanism of society, once systematized according to faultless rules, [will] never again swerve into disorder” [83]—only for these views to be later invalidated by depiction of the *endogeneity* of escalating threat to the rationalizing world-system.

Yet, this is not fatalism or defeatism: neither does it represent the equally naïve position of rejecting reason’s universalizing project outright (MWS, indeed, held ‘Burkean reaction’ in clear contempt). As we have variously established, articulating the future plausibility of extinction is a *collateral premise* necessitated by conception’s assumption of self-culpability for the totality of its endeavour, once it has extracted itself from all illusory foundations and anthropomorphic “dwellings” within non-conceptual nature. For ‘responsibility’—a deontically weighty term—comes with counterfactual entailments that are necessary to underwrite its full practical significance: for it does not make sense to talk of being ‘culpable for X’ without *also* being able to articulate what *would happen if* one reneged one’s culpability. Accordingly, MWS’s narrative, presenting the ‘ultimate anthropological stress test’, functions to put rationality’s globalized self-responsibility *into relief* by making explicit *the absolute scope* of its defining risks. One doesn’t grasp one’s obligations until one articulates their counterfactual involvements and entailments: *LM* is the narrative expression of such

self-explication. Put differently, we specify responsibilities through ‘what-if’ conditionals, and MWS’s novel is merely the long-form ‘spelling out’ of just such a conditional. *It makes explicit the content of the assertion ‘global reason is globally responsible for itself’.* This, therefore, is why MWS’s narrative furthers, rather than naïvely rejects, rationality’s self-determination of itself as a truly global vocation that is defined—rather than compromised—by its disembarking from the illusory securities of all circumspect localisms.

Fichte called this self-determining process “*Selbstbestimmung*”. Yet, just like PBS, Fichte naïvely overlooked the ineliminable endogeneity of riskiness to rationalization—thus, he compromised his conception of “*Bestimmung*” by becoming waylaid with the implausible goal of perfect insulation.

He envisioned a fully “populated globe”, in which “our species is capable of the most unrestricted communication with itself”, where “everything useful which has been found at one end of the earth will immediately be communicated and known to all”. (Thus, inchoately presaging our contemporary ‘worldwide stack’ of ‘planetary computation’ [Bratton, 2016].) By way of such exhaustive self-communication—and, thus, by being able to model itself perfectly and exhaustively—the fully rational globe is capable of perfected prediction, and, accordingly, exhaustive pre-emption:

Science, first awakened by the pressure of need, shall later penetrate into the invariable laws of nature more thoughtfully and calmly, survey the whole power of this nature, and learn to calculate its possible developments.

Thereby:

Nature must gradually enter a condition which allows one to calculate and reckon safely on its regular pace, and which keeps its force steady in a definite relation with the power [of] man.

First, simulation models the world; second, it remakes it in its own image. Through this, Fichte envisioned reason colonizing and reformatting the Earth like an omnipotent sovereign: eliminating

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“the inert and hostile atmosphere of primeval forest, deserts and swamps” and becoming *nothing but* the dwelling for the dwellers. Perfect prediction annexes, thus essentially eliminates, ‘nature’. Just as in PBS’s utopian georevolution, risk is cancelled. Fichte, indeed, claims prognosis will eventually eradicate “hurricanes”, “earthquakes”, and “volcanoes”: which are, he contends, merely “the last convulsive strokes in the formation of our planet, which is now reaching completion”; wherein “completion” indexes nature’s utter elimination under infallible pre-emptions [1987; 82-3].

For better or worse, infallible predictions are—like insurances without premiums—implausible.²⁴ Counter to Fichte’s confidence in a world insulated from its risks, most early extinction narratives example rudimentary sensitivity to the internality of threat to mitigation itself. Indeed, many envision similarly grand feats of planetary-scale pre-emption only in order that they be thwarted by equally vast peril. Odoevsky, in 4338, imagined systems such as an equator-spanning “heating system” controlling global climate: “a remarkable project, the work of centuries of scientists!” [1982; 40]. His countryman, Baratynsky, had, in his ‘Last Death’, delineated a future in

²⁴ Risk is the endogenous ‘friction’ baked-into the prognostic mechanism at multiple levels: prediction leads to mitigation, yet, through implementation (i.e. preventative policy, decision-making, warning systems) mitigation renders *new contingencies* to, in turn, compute and account for. (This is seen in the new hazards of cyber-warfare and the exploits native to planetary computation’s ‘accidental megastructure’; certainly, computers—originally designed to predict—have only made our future infinitely more unpredictable.) Bratton [2016; 102] uses the example of a high-fidelity simulation of global climate systems: the power consumption required for suitably high-resolution modelling would entail that the primary climatological event modelled would be itself. This recursive aspect of risk mitigation, and riskiness’s attendant endogeneity, makes ‘perfect prediction’ unattainable other than as a regulative ideal. Indeed, ‘risk’, at high abstraction, is nothing other than a predictive system’s inability to exhaustively track its confidences in its own predictions of strategic utilities and affordances (insofar as doing so would capture said system in infinite recursive loops, as it would allocate all its resources modelling itself modelling itself, *ad infinitum*). ‘Risk’ therefore indexes the dimensions of a recursive blind-spot that is nonetheless functionally necessary for everyday non-monotonic/practical reasoning. Philosophy calls it ‘finitude’.

which “all of nature’s force” had been “subdued to [mankind’s] ingenious laws”: through fabrication of “artificial islands” to domesticate the “rebellious seas”, and conversion of the entire biosphere into farmland [ll.25-44]. This, it is reported, is “*Reason’s magnificent feast!* [...] *this is what enlightenment had accomplished*” [ll.46-8]. Of course, these systems fail to insure against the extinction Baratynsky depicts thereafter. This dynamic had already been on display from de Maillet to Grainville, wherein Promethean feats of geoengineering are deployed to mitigate gigantic threats. (Incarnating Burke’s fears of reason’s geophysical ungrounding, Grainville imagines great excavators operating with “irresistible force” to rend “rocks as ancient as the world”: to “subjugate” the “sea” and “level mountains” whilst “penetrat[ing] to the bowels of the earth” [1806; i.112-7].) MWS, who, just like Grainville and de Maillet, talks of humanity retreating into the “bowels of the earth” to avert extermination [LM; 256], likewise stages the thwarting of civilization’s apparatus of pre-emption:

Farewell to the giant powers of man,—to knowledge [and] power that could put a barrier to mighty waters, and set in motion [...] vast machinery, that could divide rocks of granite or marble, and make the mountains plain!

[254]

Risk response, in *LM*’s stress test, miscarries: “serious plans” of nation-level prophylaxis serially fail [182], and statesmen and projectors finally find there is no “comprehensive system” that can buffer “the convulsions of physical nature” [191]. Jeopardy is ineliminable.

And so, *contra* Fichte’s ultimately naïve conception of globalization as perfect insulation, *The Last Man*’s ingenuity lies in acute depiction of the breeding of risk as dialectically complicit with the furtherance of rationality’s unfolding planetary vocation. Precarity is not simply eradicated by civilization’s successes and their uptake; instead, threat escalation moves *in step* with this process, and jeopardization is endogenous as by-product; globalization generates ever new, ever more intractable,

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ever more encompassing, ever more complex forms of hazard as part of its internal dynamic. (Indeed, late modernity, since the nineteenth century, has proved MWS, rather than Fichte or PBS, the more prescient.) Yet, *there is no going back*. Indeed, this dynamism goes all the way down, permeating even the functional horizons of the individual mind: for jeopardy is not eliminable concerning episodes we classify as ‘knowing’ because, rather, *it is the very environing condition* that enables them to be accreditable as such; because it is only by acknowledging our beliefs as precarious that we infirm unsound assertions, implement their correction, and, thus, appraise propositions as truth-apt. Truthfulness, again, is approximation and never foundation. And, once again, refusing such ‘knowledge’ as somehow too risky—in the desire to return to circumspect foundations—only provides safety in the sense that ignoring risks provides security. Admitting our existential precarity as a biological species *as well as* a normative vocation may be disenchanting, but, rather than warranting irresponsibility or defeatism, it simply *obligates us to reason ever better*. It is the summons to enlightenment. Through this, riskiness must be acceded as intelligence’s enveloping horizon as much as its internal lubricant: the loss of all firm ground and parochial affiliations—disembedding and jeopardizing though it may be—is merely the entry-fee for answering the “summons” (“*Aufforderung*”) of eternal self-improvement.

4—HIEROPHANTS OF EXTINCTION

To conclude, we turn from the critical rationalist conception of extinction and toward its overstepping and speculative abuses. We begin, predictably, with Schopenhauer. Toward the culmination of Vol.1 of his masterwork, the arch-pessimist reaches his grand conclusion regarding

his ascetic maxim, or, conviction that true redemption is found only in renunciation of the will-to-live:

Nature, always true and naïve, asserts that, if this maxim became universal, the human race would die out.

[1969; i.380]

Though Schopenhauer more commonly couches his exhortation to abstention in terms of the individual will, here he unmistakably reveals that the ultimate goal of his philosophy—insofar as this maxim, *qua* maxim, must be considered universalizable—is that of *omnicide*, or, *willed extinction*. How does philosophy, that most cognitively edifying activity, end up recommending the closure of cognition? Or, what is “very rational” about the irreversible end of all reasoning?

Kant had previously written that humanity is the “only being on earth that has [reason]”, and, thus, supposing “we regard [nature] as a teleological system”, our “vocation” is to be its “final purpose”: but *this is only insofar* as said “end” is endowed by reference to something utterly “self-sufficient” and “independent of nature”. Such a “final end”, indeed, “we must *not* seek in nature at all” [1987; 318, my emphasis]. It was upon a fatal—yet widespread—misreading of the scope of Kant’s “*not*” that extinction underwent a metaphysical inflation and became installed as reason’s suicidal “*Zweck*” or “goal” (as exemplified by Schopenhauer and his progeny): mutating ‘extinction’ from its critical formulation, as an ancillary premise collateral to undertaking global self-responsibility, to its uncritical exaggeration as the grand telos of enlightenment reasoning’s world-historical drive. And thus, to conclude, we explore this “hideous progeny”—through the brief tradition of post-Romantic philosophy that hypostatizes and absolutizes extinction as historical motor—and the misinterpretation of transcendental epistemology that engendered it.

4.1–industrial lysogeny

As mentioned, the generation of novel threats is the ‘friction’ endogenous to the inner-working of humanity’s globalizing apparatus of techno-scientific mitigation. PBS stumbled toward this, writing of modernity’s explosion of “mechanical sciences” (each pursued with “perpetually increasing vigour” and “perfection”), and diagnosing that this dynamic creates alienation (“*Nothing is now done directly*” [Carlyle, 1829; 442]) and, in fact, increases the “misery” of mankind:

Modern society is thus an engine assumed to be for useful purposes, whose force is by a system of subtle mechanism augmented to the highest pitch, but which, instead of grinding corn or raising water acts against itself and is perpetually wearing away or breaking to pieces the wheels of which it is composed.

[1920; 11]

‘*Enlightenment is self-destroying*’, in other words. Thirteen years later, George Sand’s novel *Lélia* proposed a similar prognosis. Therein, the titular character enquires “do you not see that the sun is withdrawing from us?”

Is not the earth, wearied in its journey, noticeably drifting towards darkness and chaos? [Do you not] feel the touch of that chill spread like a pall over this planet abandoned to Fate, the most powerful of the gods? [...] Cold—the sinister demon who grazes the universe with his damp wing, and breathes pestilence on bewildered nations [and] discolours all in the material as well as in the intellectual world [...] You surely see that everything is being civilised that is to say, growing cold. The bronzed nations of the torrid zone are beginning to open their timid and suspicious hands to the snares of our [frigidity]

[1978; 76]

Years prior to Clausius’s delineation of entropy, PBS and Sand both forecast for society an essentially dissipative prognosis: civilization isn’t a perpetual motion machine; it is a drawn-out explosion, thus a thermic collapse. (No surprise, perhaps, that PBS’s Eton mentor, James Lind, was friend of James Watt.) Reversibility slides into irreversibility: a ‘running out of steam’ for the ‘human motor’ [Rabinbach, 1992]. Indeed, one of MWS’s characters reports, in face of oncoming terminus, that she

“felt [as] if all the wheels and springs of the animal machine worked at double-rate, and were fast consuming themselves” [LM; 237]. As explored, threat escalation is necessarily complicit with rationalization as the ‘friction’ of its global mitigative apparatus; here, however, it is further alleged that this process will inevitably and inexorably wear itself out.

Sounding a lot like Adorno & Horkheimer, Leopardi once noted that “reason, [by] removing the illusions that bind us [together], dissolves society absolutely and turns people to savagery” [2015; 24]. He saw rationality as a roaming contradiction by which “nature often tends to harm and destroy itself” (i.e. in producing *instrumental reason*—which sacrifices expedient pleasure for future productivity—nature is contravening and eliminating its own core instincts and drives and, thus, is contradicting itself) [2015; 16]. And, like any floating contrariety, it is thus internally drawn to its resolution: in other words, *it tends to wear itself out*. Carlyle, likewise, declared that his was “the Age of Machinery”: the “age which, with its whole undivided might, [...] practises the great art of adapting means to end” [1829; 442]; or, in other words, the technical roundaboutness of instrumental reason facilitates a creeping reversal of ‘machinic means’ and ‘organic ends’, whereby industrial mechanization—originally designed to meet our every desire—becomes a damaging and self-feeding end-in-itself. Factories are mechanical cuckoos: anthropomorphic nature is usurped from within, becoming the surrogate incubator for the proliferation of “dark satanic mills”. (This all presaging Marx’s 1860s diagnoses on capitalism’s reversal of ‘subject & object’ and ‘means & ends’—his ‘*thingification of persons*’ and ‘*personification of things*’ [1988; xxiii.128].) Godwin, from the other side of the political spectrum to Carlyle, decried “man being reduced to mere machines” [2013; 99]. In Germany, Schiller noted that, opposed to the putative organicism of “Greek states”, modern

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nations are characterised by the parasitic insurrection of “machinery”: from which “out of the botching together of a vast number of lifeless parts a collective mechanical life results”. Such “mechanical life”, however, only arises via *progressive erasure* of its human host: “enjoyment”, Schiller reflected, “was separated from labour [and] means from ends”. And, in the ultimate usurpation, “[m]an himself grew to be only a fragment” within his own ramifying inorganic exoskeleton. Schiller concluded that, through this process, the “lifeless”, ultimately, “takes the place of the living” [2004; 40]. (One thinks of the automation and artificialisation of intelligence in our current era.) “Men are grown mechanical in the head”, Carlyle auspiciously warned [1829; 444]. Or, in other words, enlightenment tends to increasingly resemble the inorganic ‘death’ that it originally set out to stave off.

It is instrumental reason’s ‘principle of equivalence’ [Adorno & Horkheimer, 2002] (razing the architectures of qualitatively- and morally-infused division presumed autochthonous to anthropomorphised nature and congruently making all things fungible) that means that, as *LM* dramatizes it, “life had married death; they were one” [266]. Fichte, indeed, wrote that “[s]omething becomes contingent for someone precisely insofar as he inquires concerning its basis” [1994; 9]: hence, how and why scientific inquiry was contemporaneously busy de-sacralising ‘life’ itself. For science knows by artificialisation. And, concordantly, *we are all Frankenstein’s monster* (inasmuch as life becomes explainable and explained). The monster is no freak, and it isn’t ‘undead’ because it was brought back to life. Rather, it is ‘undead’ because it was *made* from death (i.e. through abiogenesis, rather than *ab ovo* preformation and interminable containment). And, in this very act of abiogenetic fabrication, Victor’s creation is revealed as not at all alone or aberrative. For, in reverse-engineering

organism, Victor strips from life *as such*—i.e. life generically—its sacred status as fundamental ontic category, demoting it to just another manufacturable commodity. And, as Carlyle saw, anything that can be reproduced “ceases to be marvellous, to be noteworthy, or noticeable” [2008; 45]. Rationality, it would seem, isn’t even subordinate to the organism that harbours it. Life, even reason’s own, must also be submitted to the tribunal of acidic critique: the deracination wrought by uttering the unconditioned is not just geographic, but somatic and, even, genetic.

Terminality effectuates just such an indistinction or flattening—but at a grander scale—in *LM*: wherein impending extinction is seen “brood[ing] over the earth, forcing the spirit to leave its organic chrysalis, and to enter upon an untried life” [215]; and the human socius is concomitantly reclassified as a “life-in-death”, or, as “dead earth upon the earth” [206]. MWS, accordingly, presents an episode wherein Lionel first encounters a victim of plague (complete with “rigid limbs” and “stony eyes”). “Half insanely”, Lionel speaks to the corpse. Yet, leaping up, he decides to

escape [the scene], before nature could revoke her laws, and inorganic words be
breathed in answer from the lips of the departed.

[204]

Instantly, we identify this passage as directly echoing the “inorganic voice” of PBS’s *Prometheus*. Yet, whereas PBS sought to breath *living voice* into the mineral geocosm, MWS here flips this on its head, effecting a fatal reversion: it is in fact gigantic inorganic death that *ventriloquises us* (just as industrialising capitalism increasingly makes machine ‘subject’ and mankind ‘object’). We do not reason upon death; we are death reasoning upon itself, eventually recollecting its primordial unity in the form of our comprehensive extinguishment. As Byron’s ‘Darkness’ has it:

All earth was but one thought—and that was death.

[ll.42]

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Cosmopolitan universality only in annihilation. Extinction, here, becomes legible as The Inorganic's culminating recollection of its primordially absolute status: using humanity as the disposable mouthpiece for this 'reminiscence-as-reintegration'. For, in the face of inevitable extinction, life and death become non-differentiated—"married"—to the extent that Lionel imagines pestilent extinction 'ventriloquising' life, which, in turn, retroactively annuls all of life's attempts at distinguishing itself from the death that it emerges from and, eventually, must return to. MWS's subverting reprisal of PBS's "inorganic voice" is the symbolic dramatization of this theoretical option, made available by transplanting idealism's 'absolute' with newly-articulable 'extinction'. This is why, standing as 'vanishing mediator' between Romantic idealist maximalism and Victorian positivist minimalism, the 'death of grand metaphysics' was manifested, fleetingly, as the discursive possibility of a 'metaphysics of aggrandized death'. Occupying the erstwhile position of the vital and noetic absolute, extinction inherits the characterisations of unconditionality and autarky, alongside an autonomy from any need to be defined in relation to *any* particular life or living instance. Byron's poem, indeed, concludes with a *hic jacet* for Earth's biosphere,

The waves were dead; the tides were in their grave,
The Moon, their mistress, had expired before;
The winds were withered in the stagnant air,
And the clouds perished;

Concluding thus:

Darkness had no need
Of aid for them—She was the Universe.
[ll.78-82]

An *Inorganic Absolute*, therefore. No longer always only a 'determinate negation' between living instances (which Erasmus Darwin had described as the mere phasing from "life to life" [1803; 163])

colossal abiotic ‘death’ now requires no such determining relation to any life at all, but “dwells apart” in unconditioned autonomy and autarky.

4.2—ontological austerity

How did ‘extinction’ (of all things) become metaphysically inflated, assuming dubious ‘absolute’ status, thusly? Simply, it derives directly from a post-Kantian habit of inheriting the ‘dualisms’ insinuated by critical philosophy as pertaining to ontological affairs rather than *exclusively and singularly* to semantic matters that, properly speaking, have *no* bearing on substantive matters. In short, the ‘transcendental’ does not refer to some mysterious ontic domain in excess of the empirical one [Christias, 2017]: it arises, instead, as an unavoidable artefact of discursive practice, in that language-use—functionally reliant as it is upon normativity—necessarily involves ‘*ought*’-statements irreducible to ‘*is*’-statements. This ‘irreducibility’ is semantic and pragmatic; it warrants *no* ontic commitments. Accordingly, the ‘emptiness’ of Kant’s transcendental *vis-à-vis* empirical contents should be understood, exclusively, in a semantic register as the *pragmatic* and *methodological* irreducibility of norms (i.e. ‘*ought*’-statements cannot be explained away with ‘*is*’-statements without becoming semantically ‘lossy’ [Floridi, 2017]) rather than, in a speciously substantive register, as some *ontological* poverty or privation predicable of existences (and, thus, some kind of alienation from ‘being’ that becomes *ipso facto* exchangeable with an ultimately self-destroying fealty to nothingness). Nonetheless, whether deliberately or not, post-Kantians ‘misread’ the transcendental in this latter fashion. Thus, inevitably mistaking Kantian “purity” for some kind of emaciating *ontological austerity*, their philosophies planted the seed of what was to follow from the likes of Schopenhauer.

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Fichte's 'Absolute I' could be "no real *being*, *no subsistence* or *continuing existence*":

One should not even call it an *active subject*, for such appellation suggests the presence of something that continues to exist and in which an activity inheres.
[1994; 26]

Fichtean I-hood becomes total *absconditas*. Adorno & Horkheimer read the transcendental similarly: accusing the Kantian subject of being drowned too thoroughly in its own pool of negativity such that it becomes actively etiolated; for, 'according to the methodical extirpation of all natural residues [the transcendental ego] must no longer be either body or blood, or soul, or even the natural I'; resulting in the chimera of the 'transcendental or logical subject' [2002; 22]. Likewise, Schelling, in 1797, triangulating this dark domain, identifying it as the "standpoint from which [we] examine the world not within the world itself but outside of it" [1994a; 102]. Yet, as MWS well knew, "*to quit the world*" is nothing other than to be extinguished within it. ("All the world has the plague", Ryland grieves in *The Last Man*. Adrian, with "gentle smile", wryly responds: "Then to avoid it, we must quit the world" [191]. This, of course, is precisely what humanity does.) Indeed, the 'ontological anaemia' of post-Kantianism's unconditioned easily slides towards 'meontic superlative'. Thus, the blinding negativity beneath the bedrock of Schellingian metaphysics: the self-moving "nothing" of his primordial "Godhead" whereby all being is founded on "active negation" [2000; 32]. This "highest simplicity", therefore, is necessarily "that which is without nature" and "is not a being and does not have being":

It is not divine nature or substance, but the devouring ferocity of purity.
[2000; 25]

The transcendental's eviction from existence, consequently, is duly inherited as the 'devouring ferocity' of metaphysicalised nothingness: sealing itself off from being—imploding toward zero—the transcendental ego becomes ontic blackhole.

This did not go unnoticed. Coleridge identified it, desecrating his German Idealist peers for placing “*Nichts*” at the base [CM; vi.242-3].²⁵ Jacobi pronounced transcendentalism as “*Nihilismus*” and Richter duly reported Kantianism’s “critical basilisk eye” as “preying on the whole universe” by negating everything in its view: from quotidian objects all the way up to entire galaxies [1992b; 197]. In England, Peacock cast Kantian “*Pure Intelligence*” as annihilating darkness: a “tenebriose view” of “wilful blindness” onto the “LUMINOUS OBSCURE” of “deisdæmoniacoparadoxographical” nihility [1817; iii.25-40]. Similarly, Carlyle’s transcendentalist fool, the orotund Herr Teufelsdröckh, had likewise claimed that humans “walk on the bosom of Nothing”; for, to “sit above it all” is *necessarily also to concomitantly* dissolve into “the vast, void Night” [2008; 17-8].

When transcendental emptiness (i.e. lack of empirical content) is misinterpreted as an ontic predication rather than semantic artefact, ‘purity’ becomes interpretable as total self-oblation and ‘annihilation’ easily becomes inflated into the toxic core (or “*Urtrieb*”) of rationality’s self-unfolding: thus, unbinding itself from every local horizon, apophatic reason arrives as the comprehensive annihilation of all of them, *toto mundo destructo*. For reading universality’s ‘view from nowhere’ as substantive (rather than regulative) in scope it becomes indistinguishable from *real self-negation*. Schelling himself is explicit, claiming that—from the perspective of this deadly ascent—“all Being goes up [in] flames” and this vision-from-nowhere is “necessarily unapproachable to anyone still embroiled in Being” [2000; 25].

²⁵ He was particularly aghast by Oken’s founding his entire cosmogony upon the serial positings and unpositings of a basal ‘empty-set’, or, ‘generative zero’ [Grant, 2006; 84]—calling this the “Mother-Lie of the whole Brood of Okenisms” [CM; iii.1049-56]—and going so far as to accuse the system of “Buddhism” [CM; iii.1053] (serendipitously presaging Schopenhauer’s [1969; ii.608] ‘love affair’ with Buddhist ‘*Sunyata*’ or ‘emptiness’).

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And so, serially deriving from this founding miscomprehension of the transcendental's scope, the self-contradictory nature of the post-Kantian 'ego-as-blackhole' (filiated with nothingness—yet somehow exiled into being—understandable, thereby, as a self-cancelling disequilibrium striving for its return to nihility) ignites both the historical dynamo and a tragic undercurrent detectable within Absolute Idealism: redefining individual cognition, *qua* roaming contradiction, as tormented “*streben*” for equilibrium, whilst simultaneously reformatting the Romantic *ur*-narrative of the 'circuitous journey' as the pulsional desire to absolve its own contradictory existence via complete resolution into aboriginal nothingness (Schelling's “devouring ferocity of purity”).

This *ur*-narrative of 'alienation and re-integration' [Abrams, 1971] finds its purest philosophical articulation in Fichte's procedural account of the thetic movements of the “Absolute I”. Representing his prime innovation, this distils the Fichtean logic of *unilateral determination*. Briefly, the 'non-absolute' (i.e. existence) distinguishes itself from the 'absolute', yet the 'absolute' (*qua* undivided and autarchic) does not distinguish itself in turn (rendering a one-way differentiation), such that all of the non-absolute's temporal posturings and positings of distinct existences and evolutionary haecceities are revealed as, in fact, nothing but the absolute's procedural reassertion of its own atemporal unity and indistinction. In other words, 'existence' is nothing but the absolute's forgetting of its undivided status, and 'history' is nothing other than the interval of its recollection of austere unity and “*Indifferenz*”. (Hegel: “the consummation of the Infinite End [...] consists merely in removing the illusion which makes it seem yet unaccomplished” [1874; 303].) Fichte, for whom the founding principle of one's own philosophy could not be anything apart from personal “*inclination*” [1994; 18], thereby left a fundamental 'use agnosticism' at the base of this powerful logic of 'alienation and

re-integration’—opening up, thereby a *modularity* concerning the terms one can put in play therein—for, although Fichte’s ‘absolute’ term is undoubtedly ‘*logos*’ or ‘universal right’, it could just as easily be switched out for ‘inorganic death’ or ‘universal terminus’.

Thus, the troubling capacity for the ‘circuitous journey’ of otherwise ‘healthy’ Absolute Idealism to recurrently revert into a baneful “*Schwärmerei*” for death, or, ‘thanaticism’. For, from the “*Todessehnsucht*” of a *Werther* or *Alastor*, to Fichte’s decree that “individuality must ceaselessly die off” [1994; 90], to Schelling’s natural drive toward “annihilation of the individual” [2004; 40], the creaturely, in Romantic Idealism, is often cast as constantly “striv[ing]” to “revert to universal indifference”, with “life itself” being “only the bridge to death” [Schelling, 2004; 68-9]. This can easily sound more like extinction than apocatastasis. “Left to itself, nature would [lead] everything back [into] utter negation”, Schelling intoned [2000; 31].²⁶

Unilateral logic, that is, translated the *entirety* of cosmic existence into the Absolute’s amnesia for its “devouring purity” and “highest simplicity”, and history as nothing but latency on its recollection of this founding indistinction, thus recasting all individuated and intra-temporal existents as mere vehicles for the historical manifestation of this remembrance. Thus, switching out ‘I-hood’ and transplanting ‘extinction’ as absolute term (insofar as, as Fichte himself admitted, it is based on “*inclination*”) the logic of Byronic ‘Darkness’ becomes clear: the negentropizing “Universe” may have fooled itself, circuitously, into acting *as if* it were distinct from entropic “Darkness”, but, *in the final instance*, “Darkness was the Universe”.

²⁶ The magnetist C.W.F. Hufeland wrote of a “striving for unification with general nature” via “death”: a libidinized sinking back to “anorganism” [Sloterdijk, 2011; 250-1].

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Accordingly, this “world shall be former” as Byron vaticinated. We are already “dead earth upon the earth”, puppeteered by an “inorganic voice”. “Ye are all going to die [and] already your tomb is built up around you”, Lionel similarly predestines [*LM*; 189]. Certainly, MWS crowns her plague as “supreme Providence” [213]. For, as Leopardi dictated, extinction is the “magnificent progressive destiny of humankind [‘La ginestra’, ll.49]. Thus, PBS’s “gigantic shadows which futurity casts upon the present” [2002; 535] are recalibrated, within *The Last Man*, as “shadows of [the] future [which] rose dark and menacing from the womb of time, their cradle and their bier”:

futurity, like a dark image in a phantasmagoria, came nearer and [nearer],
till it clasped the whole earth in its shadow.

[201-2]

Accordingly, inorganic terminus, rather than Fichteian “logologia”, becomes installed as *the protagonist* of world-history: we do not reason upon extinction; to reason is extinction procedurally realising itself. Enlightening is merely the intratemporal medium of extinction’s incarnation. Hence, given this framework, why the ‘threat escalation’ endemic to globalizing modernity’s world-interior could so easily become inflated into some specious teleological identification between ‘emancipatory enlightenment’ and ‘entropic extinction’ (unwarranted and metaphysically dubious though this is). Turning to the culminating extravagance of this speculative inflation, we identify how this absolutization of extinction duly mutated into a bizarre soteriology.

4.3–euthanistic soteriology

The late Coleridge’s philosophy of redemption, in distinctively unilateral mode, cast all of natural existence as “a living Antithesis, incapable of any equilibrium” [*CN*; v.6405]. Nature, as *vallis lacrimarum*, is a “fallen non-absolute” or “Apostasis” that willed itself (satanically) as separate from

the Divine Absolute; yet, since such autonomy is logically impossible (because the absolute is definitionally indivisible), the entire cosmos is engendered forthwith as a pulsing paradox—or “Self-contradiction”—that, concordantly, desires its own absolution through negation. An abscess of false existence or tumefying *privatio boni*, nature is a “<Self->Contradictionreity suspended, and forced asunder to become” through hydraulic striving for its own resolution [CN; iv.5240].²⁷ Natural history—culminative in mankind and subsequent theophany—is thus the arrival of nature’s erasure; or, only in cosmic annihilation does salvation arrive. Though Coleridge steadfastly couches this in redemptive and theistic terms (and was convinced of an afterlife), this nonetheless displays deep conceptual isomorphy with Schopenhauerian ‘soteriology of extinction’—showing the one is only a step away from the other (again, demonstrating how easily ‘healthy’ Idealism can slide into terminalistic fatalism).²⁸

For, in Schopenhauer, likewise, the entirety of natural existence is a form of tumorous apostasy from primordial nothingness, a self-moving disequilibrium within universal negation’s stillness: for, in deceitfully willing itself as distinct from nothingness, existence becomes a kind of *parasitic invasion* or tumefaction, inasmuch as it asserts its own antagonistic ends (the furtherance and prolongation of the cosmos’s grand procession of suffering) yet is also, ultimately, dependent upon its host (as,

²⁷ Presaging Hegel (whom Coleridge dipped into but never sincerely engaged with), ‘contradiction’ becomes history’s driving pump rather than a sterile logical infeasibility.

²⁸ The late Coleridge shares Schopenhauer’s pessimistic kernel: both being fundamentally motivated by the biblical ‘vale of tears’ topos. Coleridge casts nature’s universal striving and willing as a “clinging wrestle [and] old war-embrace” and, consequently, warned against talk of the “goodness, loveliness, beauty &c of Nature” [CN; iv.5249]. *Nature is pulsing torment*. McFarland thereby notes Schopenhauer is Coleridge’s ‘continental antithesis’ [Coleridge, 2002; clxxxv]. The one would have certainly found the other risible (one a Christian apologist, the other a vociferous atheist) yet trivial divergences of taste bely deep-set symmetries.

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unilaterally speaking, it is indistinct from the nothing it emerges from). Schopenhauer is explicit: mindedness is a virus. For, as nature’s most exaggerated blossom, the cerebrospinal system is “in fact a parasite [...] insofar as it is not directly geared to the [rest of the] organism’s inner-working”: thus, rather than nature’s “most sublime flower” (as Schelling [2012; 204] championed the brain), the invading spinal root and its encephalic “fruit” are now, contrarily, the “efflorescence” of a self-feeding instability and parasitic contradiction [Schopenhauer, 1969; 243-6].²⁹ Accordingly, it becomes a strictly ‘analgesic’ matter of ‘disinfection’, then, to abolish consciousness (the human cerebrospinal system) and resolve its destabilising contrariety. For Schopenhauer, therefore, *eudamonia is euthanasia*. This is the deeply soteriological core of his philosophy.

For Schopenhauer and Coleridge alike, cosmic history is thus the taxic movement toward the resolution of existence’s self-contrariety via its culminating self-abnegation. Both, consequently, were fond of Romans 8:22 (“For we know that the whole creation groaneth and travaileth in pain”). Coleridge was convinced that humanity is the “final crown [and] the Ends of the redemptive work” for which “the whole Creation groaneth to be redeemed” [CN; v.6291]. Schopenhauer, too, cites Romans 8:22 in support of his idea that “the rest of nature has to expect its salvation from man” [1969; i.381].

Why, though, does *Homo sapiens* bear this cosmic burden: acting as “solution” to universal suffering’s “dark Enigma” [CN; iv.4984]?

²⁹ Coleridge, identically, classified the “centro-peripheral system”—i.e. nervous system—as prime symptom of his apostate will [CN; v.6296]. Schopenhauer inherited the parasitism idea from Tiedemann [1824-37; i.62].

It is because, as Schopenhauer well knew from his Absolute Idealist training, *all* natural existences (all “those numberless spheres freely floating in boundless space”; all those “innumerable [beings] that throng, press, and toil”) are “in the first instance” only a “*phenomenon of the brain*”. Concordantly, if noumenal reality is the symptomatology of invading cerebrospinal virus—if *the content of existence is itself neural invasion*—then weed out the parasite and noumenality correlatively obsolesces *toto genere*. Schopenhauer, tellingly, cites Rom 8:22’s salient passage *just after* petitioning his ascetic maxim be absolutized and the human race abolish itself. For, if the “maxim become universal, the human race would die out” and, with it, “[that] weaker reflection of it, namely the animal world, would [conterminously] be abolished, just as the half-shades vanish with the full light of day”, triggering another ‘meontic cascade’:

With the complete abolition of knowledge the rest of the world would of itself also vanish into nothing,

This is why “nature has to expect its salvation from man *who is at the same time priest and sacrifice*” [1969; i.380-1]: an atheological soteriology. With all this, we fully understand Byron’s adjudication that “[t]he Tree of Knowledge is not that of Life” [2008; 275]. Given Schopenhauer’s reasonings, intelligence becomes existence’s way of killing itself: it is the vehicle for enacting the utter negation that consumes the universe itself. ‘Ego as blackhole’, indeed. Just as ‘the Universal’, as soon as it is uttered, cannot help but bootstrap to ultimate catchments, Schopenhauer similarly envisioned intellogenesis as a cosmic process culminating in the enunciation of a negation so powerful as to cannibalize not only its enunciator but, also, the fabric of existence itself. The true point of “*Indifferenz*” for post-Kantian “real-idealism”, therefore, becomes universalized suicide. And so, from the perspective of this predestinal nihilitory salvation, the entire upswell of natural history and

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civilization is retrojected as the *pupation* of cosmic terminus, and the cephalizing human brain is cast as preparatory chrysalis for its self-realisation: this view of evolution’s “most sublime flower”, therefore, darkly reconfigures PBS’s classification of the philosopher-poet, who, as the “hierophant” of futurity, “beholds the future in the present, and his thoughts are the germs of the flower and the fruit of [the] latest time” [2002; 514].

4.4–slavic tenebrosity

To close, we gesture towards a forgotten tradition of nineteenth century philosophy explicitly foregrounding—and extremifying—these tragic aspects inherent to post-Kantian idealism. Before this, however, we record the poetic apex of Romantic darkness regarding this speculative inflation of extinction. For this, we return to Moscow and its ‘*Lyubomudry*’ circle. Here we clearly encounter the confluent influence of MWS’s *The Last Man* and Byronic ‘Darkness’, alongside the baneful climax of the suicidal strain in post-critical metaphysics.

4.4.1—voluntary omnicide, 1827

Baratynsky’s 1827 ‘Last Death’, as explored, uses a dream-frame to catapult the narrator into a future resembling Fichte’s utopic “*Erde*”. Planetary-scale geoengineering has made the entire surface optimally hospitable and prediction has tamed all of nature’s hazards: it is a state of completed “*enlightenment*”. The vision unfurls into resplendent uchronia, similar to Odoevsky’s 4338: “Earthly desires forgotten [humanity] eschewed / such primitive attractions, and the summons / of spiritual dreams [instead] / supplanted them” [ll.61-4]. Echoing Fichtean idealism’s goal of nature’s total annexation (subsuming contingences via predictive mastery), Baratynsky accordingly claims that “in [this] world the nature of the body / gave way before the nature of the mind” [ll.67-8]. However,

hinging on the paradoxical inflammation of ‘transcendental non-naturalism’ as reverting into a damaging form of ‘ontological anaemia’, it is seen that instrumental rationality and enlightenment—in alienating us from our animal natures and sublimating our natural desires—makes us existentially asthenic and impotent to the point where we fall out of existence entirely. Global non-naturalisation dialectically reverts into global extinction: that is, the fully enlightened populous moved “on wings of living thought” through the “Empyrean” of idealities, but “on the earth they moved with heavy footsteps, / and many of their marriages were childless” [ll.69-72]. *Or, with rising intelligence, fertility collapses*. Eventually, saintly humanity subtilizes itself out of existence entirely. As Leopardi had presaged, “[r]eason is the enemy of nature” [2015; 330].

This limns a kind of voluntary extinction: the notion that, with sufficient education, a suitably intelligent species would inevitably opt out of existence (i.e. propagation) entirely. Enlightenment (as detachment from the ‘nonage’ of biological instincts and inclinations) here eventually disabuses the desire to reproduce itself, abrogating the ‘*existence bias*’ at the core of organismic sentience [Metzinger, 2017b]. As such, the anti-natalist injunction (that ‘non-being is axiologically preferable to being’) takes hold. Infertility reigns supreme. And so, in Baratynsky’s vision, utopia transmutes over the centuries into “horrifying spectacle” as “Death walked abroad, on land, and across the seas” [ll.4-5].

“Abandoned and in ruins the cities stood” [ll.80], Baratynsky augurs: *Homo sapiens*, so ‘enlightened’ that it no longer cares for its physical continuation, simply *forgets* to exist. In the end, this leaves only “deep silence” and “regal Nature”—“enthroned / throughout the world”—lording over a “melancholy [...] scene / of empty valleys, woods, and streams”.

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The sun rises on a deserted world. It is beautiful, yet “now upon the earth nothing was able / to utter any greeting at its ascent”,

There was only mist, dark blue and twisting,
like cleansing smoke from a sacrificial victim

[85-96]

(We recall Schopenhauer’s exhortation that reason become both *priest* and *sacrifice*.) And thus, Baratynsky projects a mighty vision of how incandescent utopia dialectically reverts into blinding extinction: here, our apostasy from ‘natural instinct’ is seen not as the construction of a superadded, yet autonomous, ‘second nature’, but, insofar as first nature always (in the last instance) reasserts itself as absolute (from which all ‘autonomy’ is thereafter revealed as a conspiracy with self-negating contradiction), contriving ‘second nature’ is, in the end, definable as nothing but *exiting existence itself*. Again, misreading the transcendental’s autonomy as substantive rather than normative in scope, ‘second nature’ becomes nihilating egress rather than supervenient vocation.

Baratynsky’s overall model is clearly Byron’s ‘Darkness’, which, as explored, took fertile root in Moscow due to deep-set alienation throughout post-Decembrist society. (As Kelly [2016; 19] records, the ‘Russian version of Romantic revolt [inherited] a special tragic resonance and intensity of philosophical reflectiveness’.) We now turn to Odoevsky’s ‘Last Suicide’. Whereas Baratynsky’s vision of extinction is tranquil in beautiful desolation, Odoevsky’s is shockingly ferocious in devouring sublimity. Significantly, the major inspiration was MWS’s *Last Man*.

4.4.2—thanatic schwärmerei, 1844

The polymathic Odoevsky was proficient in English, acquiring MWS’s *Last Man* in the original and imbibing it. He reviewed it in the *Moskovskii vestnik* the year after its publication. In this 1827

review, the Prince is critical and demeaning, claiming the topic would have “majestically unfurled” under “Byron, Goethe, or Jean Paul” and that the present author “could not fulfil this task” [1827; 179-81]. Accordingly, Odoevsky was inspired to re-collate the “scattered and unconnected” materials of MWS’s ‘sibylline leaves’ himself, producing his own permutation. This took the form of his ‘Last Suicide’, a vignette from his eighteen-part *Russki nochi* or *Russian Nights*.

A panoptic and kaleidoscopic synthesis of the major trends in Slavic conversation across the nineteenth century’s opening decades, and standing as literary summa of an idiosyncratically Russian Romanticism, 1844’s *Russkie nochi* constellates multifarious contemporary issues: the sense of alienation created by the leapfrogging rapidity of Russia’s Enlightenment across the previous century, alongside the largely imported nature of such “*Aufklärung*”; the acute sense of lack of an identifiably Slavic philosophical self-consciousness and literary tradition [Clowes, 2004; 17-9]; the ensuing ‘Westerniser/Slavophile’ debates of the 1830s; the love affair with German Idealism, and particularly *Naturphilosophie*, amongst Moscow’s Academy of Sciences and intelligentsia [Walicki, 1979; 76]; and the position of disenchanting rationality and science relative to a idiosyncratically Russian view of social value, given the recent ingress of orthodoxy-threatening fields like palaeontology and geohistory [Kelly, 2016; 8-87].

Like its author, however, *Russkie nochi* can’t easily be placed on either side of the debates energizing contemporary intellectual life. The work opens, suitably, with a debate on Enlightenment. In Enlightenment, “mind and will are strained—time and space are turned into nothing”; in Enlightenment, “your soul has turned into a steam engine”; in Enlightenment, the “social machine [is] falling apart”; in Enlightenment, the society that “would pacify vicious passions” dialectically

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“suffers for lack [of] strong spirit”; in Enlightenment, “your hands are bloodstained”; and yet, in Reaction, “you are tongue-tied” and “nature is obscured to you”. One interlocutor claims that, of late, the world is filled with “nothingness”: “Lack of enlightenment!”, one diagnoses; “Excess of enlightenment!”, interjects another [1997; 35-9]. No final word is supplied. The answer, such as it is, is instead *dialogically simulated* across the preceding vignettes, as miniature thought experiments wherein the interlocutors’ question “What’s enlightenment?” is put to test.

Like a ‘matryoshka doll’, *Russkia nochi* is a ‘multilayered frame tale’ interpolating various philosophical tales explicitly staged as thought experimentations [Grigorian, 2013]. ‘The Last Suicide’ is just such a procedure. Grigorian [2014; 4] notes that it lies at the beginning of a ‘long-standing tradition in Russian science and thought’ engaging, critically, with hypothetical experiments upon social issues such as Malthusianism: producing a counterfactual alembic within which to contest the East/West distinction and extract philosophical conclusions forthwith. (Later examples include Chernyvshevsky’s 1863 *What is to be done?* and the ‘nihilist and anti-nihilist’ novels during the generation of Turgenev.) From the outset, the tale is framed as “nothing else but a development of a chapter in Malthus” [1997; 91]. The story, that is, models a world undergoing Malthusian collapse segueing into human extirpation. In frame and content alike, it plays out as critical occupation and extrapolative *reductio* of the simulative-prognostic paradigm of Western techno-science: with Odoevsky fundamentally warning that to be too occupied with the future (through ‘instrumental reasoning’) is to sacrificially emaciate your present reality. Specifically, it simulates voluntary human extinction in order deliver the payload of its *ad consequentiam* argument against the disenchanting economism of Western thought and its “dismal science”. Yet, as becomes clear, the frame-content

incubates an unrelenting and untrammelled negativity that overrides and destabilizes the didactic intentions of Odoevsky's frame—usurping them from within.

We are instantly alerted to the tenebriose intensity of the work by the fact Odoevsky apologizes for it, in the frame, as a “truly monstrous creation” (“**ЧУДОВИЩНОЕ СОЗДАНИЕ**”) [1997; 91]: one cannot help but think of MWS prefacing *Frankenstein* as her “hideous progeny”; or, Richter pre-emptively excusing the “audacity” of his ‘Dead Christ’. The tale itself opens, recognizably, in futurological register:

The time predicted by the philosophers of the nineteenth-century arrived: the human race had multiplied; the balance between nature's production and the needs of mankind were lost.

[91]

Here we already encounter the ‘looping’ characteristic of the future perfect: wherein the present (here the “nineteenth-century”) becomes increasingly entangled in its own predictive horizon, such that thought becomes determined by what *will have already happened*. The prediction here is one of ‘plenitude become putrefaction’. Urbanization and over-population, in other words, grip the future world. “[T]he fields turned into villages, villages into towns, and the towns imperceptibly expanded their limits” [91]: when civilization becomes a steam engine, cities are attendant explosions. They cannot but expand, as the very essence of the ‘polis’ is to tumefy into ‘megapolis’. Odoevsky, therefore, acutely presents this as inherently hitting up against ‘limits to growth’ (darkly translating Kant's intuitions on “hospitality” and the finity of global space in *Perpetual Peace* [1991; 106]): urban clusters bootstrap themselves, converging into one world-enveloping cosmopolis; the “cities limits merge, and the whole earth from pole to pole, turned into an immense inhabited city”; yet, rather than enforcing “hospitality”, this instead creates ‘behavioural sinks’ as “all the diseases [and]

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depravity” of city-life concentrate and converge [92]. Just like globalizing reason, urbanization is cast as pandemic, encasing the terrestrial surface in its inorganic film. Once more, civilization’s extension of human means increases only in step with growing “pain” of “perhaps a worse kind” than prior wants (again, ‘means-ends reversal’): for, in eliminating “hunger”, overpopulating humanity surges in “crimes, perfidy, and diseases”. In tandem, news envelops entirely—collapsing planetary time and space—as “perfected means of communications carried news of the horrible phenomenon of starvation and diseases into all parts of the globe” [96]. Another precursor to ‘planetary computation’ as the organon of global self-reflexivity (whereby the world models itself not yet numerically or electronically but discursively via encompassing public spheres). Yet the global commune models itself only under the sign of its own erasure, for the ‘universality’ modelled emaciates the local conditions of modelling: that is, coeval with total connectivity is crippling exposure to “contagious disease”—duly rendering planet-saturating pandemic—such that the very means of universality’s self-representation are depicted as fatally self-cancelling. Connectivity is ‘infection vector’ as much as ‘perfected means’: threat escalation being endogenous to modernity’s world-interior. Perfected connectivity, *contra* Fichte, does not entail exhaustive pre-emption but, here, becomes catalyst for “all-enveloping disaster” emanating from the ‘fully enlightened earth’ [92]. At length, urbanization’s runaway explosion evicts the “plant world” and “animal” from the earthly surface: exterminating all non-human organism as cosmopolis smothers the planet. Humanity commits ‘geocide’: announced by the “luxurious universal city” comprehensively asphyxiating the biosphere. Geoengineering is deployed to support this planet-wide giga-city, with deserts cultivated and tundra irrigated. “[B]y enormous efforts of chemistry”, even the poles are “illuminated” and “enlivened” with “an artificial

sun” [92]. Yet, as soon becomes apparent, this ‘second nature’ once again is condemned as nothing but nihilatory egress from natural existence. For, once again, apprehending rational purity as substantive poverty rather than normative irreducibility, ‘second nature’ is *no* nature at all (wherein the quantifier ‘*no*’ is indiscriminately annihilative rather than merely a determinate negation expressing a distinction of domains). A politics of exhaustion ensues: all mitigating remedies are “to no avail” [96]. Rational utopia dialectically slides into universal extinction: “everything was bursting with life, but life was killing itself” [92]. “Life appeared as superabundance, more horrible than hunger” [96].

Here things get interesting. Anti-natalism soon takes hold due to over-population, with “[s]uicides ranked as heroes” and parents murdering their own babies. Sanctions are made against “marriage”; children deemed “illegal”; saving another life becomes taboo [93]. All this mutates humanity’s psychology and value-systems: a new “dark and horrible feeling”—a longing with “no object”—spreads abroad [94]. Next, there emerge the *thanatic philosophers*: an intellectual priest-caste, hierophants of death, midwives of omnicide.

Soon there appeared among them men who seemed to have been keeping count of man’s sufferings from ancient times—and as a result they deduced his entire existence.

It is said that these “prophets of despair [had] measured the suffering of each nerve in man’s body, of each [torment] with mathematical precision” [94]. Resembling Hartleyan doctrine retrofitted onto nociception, this is a riff on utilitarianism (indeed, the subsequent story in *Russkie noch*i is a send-up of “Benthamia” [107]): another *reductio ad absurdum*, based on the ‘if-then’ that the project of mathematically quantifying qualia will inevitably output an existence-adverse axiology (and, accordingly, is a misguided endeavour). That is, presaging the arguments of the late nineteenth

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century ‘Pessimism Controversy’ [Beiser, 2016], Odoevsky implies that to ‘measure’ qualia is to have already missed their qualitative value; hence, ‘putting a number to pain’ will inevitably conclude that existence is of negative worth. And yet, once again, the content of this *absurdum*—in its intense, unrelenting negativity—troubles Odoevsky’s moralistic argumentative goal from within.

4.4.3—the eldest system-program of nihilative idealism

The thanatic philosophers, having computed a comprehensive taxonomy of present-day human anguish, turn their view to the Schellingian “transcendental past” (allowing pain to ‘become genetic’, on the plan of *Naturphilosophie*’s hypostatisation of the transcendental as preconscious natural history):

Their boundless insight grasped the past and pursued Life from the moment of its inception.

[94]

Through this, these “prophets of despair” produce their completed system of everted idealism: synthesizing a sweeping evolutionary physiogony—leading from protozoa to primate—offered as the grand genetic deduction of human suffering; and yet, excoriated of any amniotic “*Weltseele*” or utopian “*Bestimmung*”, this cosmogony instead places Sadean desecration and anguish in the driving seat of history.

They recalled [Life], thief-like, creeping first into the dark clod of earth, and there, between granite and gneiss, destroying one matter by another and slowly developing new, more perfect creations; then she made death of one kind of plant bring about the existence of others; by destroying plants she multiplied animals. With what cunning she made the enjoyment, the very existence of one kind depend on the sufferings of the other!

[94]

Usurping life is here seen parasitically invading placid inorganic repose: puppeteering it into evolution’s long-drawn-out ruse. Odoevsky, that is, here inhabits the Fichtean unilateral logic and

subverts it by exploiting the modularity of its ‘absolute’ term. In other words, we, as living instances, tend to think of life as teleologically distinct from dying (one is ‘production’; the other, ‘collapse’), yet, Odoevsky’s thanatocists exploit unilateral logic to argue that, if we only live to die (in ever more variegated and exquisite forms), then the distinction that the living makes from its own death is, teleologically speaking, annulled. Echoing Sadeanism, biotic evolution serves only to invent *ever more prodigal forms of dying* (just as, at cosmic timescales, civilization’s negentropic upswell becomes indistinguishable from accelerating cosmic entropic equilibrium). Thus, looking back from the end, there is no distinction between striving organism and its immolating terminus. As Leopardi put it in his notebooks, “We do not live, except in losing” [2015; 329]. Hence, the invasive imagery of puppetry—yet another ‘inorganic voice’—because ‘to live’ is merely to be ventriloquised by your own unavoidable terminus.

With what cunning [Life] made the enjoyment, the very existence of one kind depend on the suffering of the other! They recalled, finally, how ambitious Life, extending her authority from hour to hour, kept increasing the irritability of feelings, constantly adding new ways of suffering to a new perfection in each new being until she created a human being, and in his soul she unfolded with all her reckless activity

[94]

Evolution is an engine for pain-optimisation. The neurulating assembly of centralizing nervous systems is merely the crowning blossoming of sentient nociception, or, *a way for suffering to feel itself* (a most noxious “efflorescence”). And, with the subsequent advent of sapience, and philosophy and science in train, ratiocinative discursivity endows suffering, in addition, with means to *vocalise and measure itself* (subsuming all ‘curiosity’ and ‘inquiry’ under this goal). Nonetheless, it is duly noted that “inexorable Life” prolongs its tumorous existence (misguiding its hosts away from analgesic suicide) by installing illusions and chicaneries (ideals, values, and qualia) protecting one from “seeing

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all the ugliness” of cosmic existence: “[life] carefully covers [mankind’s] head and heart to keep the instruments of future torture within them intact” [95]. (As Freud later noted of the same realisation: “[t]hus the guardians of life, too, were originally the myrmidons of death” [1963b; 39].) And so, whilst Odoevsky refers throughout to this invading force as “Life”, he ultimately betrays that he is all the while talking only of self-exaggerating death, insofar as death has become the subject *and* object of universal history. Indeed, as Baratynsky’s own title, ‘The Last Death’, ingeniously communicates over its ‘Last Man’ peers, ‘Man’ is no longer even the subject of predicated lastness: terminal extinction is now both predicate and the subject predicated. Humans, as living instances, are mere energumen of an inorganic voice, or, to mangle Malebranche, mere thoughts in the mind of colossal extinction: “*She was the Universe*”.

4.4.4—the last messiah

Once more, global eudaimonia slides into global euthanasia. The thanatical doctors pledge themselves to the “only true and unfailing ally against [cruel existence’s] contrivances—to nothingness” [96]. Only here (in “sweet embraces of nothingness” [94]) is the arsenal “against violent life” to be found. *Redemption is strictly meontological*. And so, a nihilist millennium dawns. Recalling MWS’s cosmopolitanism-in-extinction, alongside Kant’s darker prognoses upon “perpetual peace”, a global communitarianism is achieved only in mutual *Weltschmerz*: all citizens alike are united in millenarian thanatropism; it is reported that this is the ‘equality’ politicians had long only dreamed of; “[w]e are very tightly united with one another; we are members of one family!” [96]. The philosophers’ sermon of terminus takes root:

it penetrated men’s souls like seed into ready soil, and it grew like an idea that has long been developing in the heart’s deep solitude.

[97]

And, with this, world-history reaches its culminating ‘*omega point*’: that “final end” that Kant had announced, not to be found “in” nature. It is announced that

at last, he came, the Messiah of despair!

[97]

A Last Messiah. Indeed, the Inorganic Absolute, as a deified death, evidently requires its own world-historical and christological incarnation—*its own prophet*—by which its infinitude enters finite history.³⁰ Upon his pontifications, the Terminal Messiah’s “words dispersed the [final] remnants of ancient beliefs”:

He was swift in pronouncing the last word of the last thought of mankind—and everything was set in motion.

[97]

That is, Odoevsky’s “*toten Christus*” ushers in the End of History. For, on his injunction, “all efforts of art, all ancient achievements of anger and vengeance, everything that could ever kill man, everything was summoned, and the vaults of the earth crumbled under the light cover of soil; and artificially refined nitrate, sulphur, and carbon filled them from one end of the equator to the other” [97]. One last, self-destroying act of geoengineering: with Burke’s fear of ‘revolutionary reason’ putting dynamite under the world’s foundations, once more, fatally literalized. The nihilating millennium impending, an inverted typology of Adam & Eve emerge (in the manner of Grainville’s Omegarus & Syderia) to plead for life and hope at the penultimate moment. The petitions of this

³⁰ Odoevsky neatly presages P.W. Zapffe’s 1933 *The Last Messiah*, which augurs a prophet-to-come, who, finalizing the human philosophical project, persuades the world “Know yourselves—*be infertile, and let the earth be silent after ye*” [Zapffe, 2016].

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conjugal pair are, however, swiftly denied by the rest of humanity—drunk in thanatical bacchanal.

The world detonates. To quote in full:

At a fixed, solemn hour, people finally fulfilled the dreams of ancient philosophers about a common family and general agreement of mankind. Wild with joy they joined their hands. Thundering reproach was in their eyes. Suddenly a young couple [...] appeared from under a clod of earth; pale and exhausted, like shadows of corpses, they kept pressing each other in an embrace. “We want to live and to love amidst sufferings,” they shouted, and falling to their knees they implored mankind to stop the moment of its vengeance; but this vengeance had been nursed by centuries of life’s [sadistic] generosity; terrible laughter came as an answer; it was a prearranged signal—the next moment fire flashed high, the roar of the disintegrating earth shook the solar system, torn masses of Alps and Chimborazo flew up into the air, groans were heard...then...again...ashes returned to ashes...everything became quiet...

A true Millennium of the Dead Christ. And so, coming full circle, this presents the *catastrophic reversal* of the georevolution metaphorically championed by secular millenarians from PBS to Hegel, with their symbology of the fully enlightened earth shedding its crust and erupting with reason’s blazing light; for here, instead, rationality’s deracinating tendency to eliminate all localities is ‘*brought down to earth*’ and violently materialized as literal planet-shattering; the rational map, that is, obliterates the lived territory; and, thus, rather than the utopic *Erde* sublimating its inorganic mantle—via annexation of nature’s “wild mass”—so as to idealize and civilize our planetary dwelling, we here see global extinction sloughing off its civilizational chrysalis, revealing all the travails and groans of terrestrial history as merely its intratemporal gestation.

4.5—omnicidal metaphysics

Though undergoing a relative disappearance in literary works during the latter nineteenth century, the issue of extinction became utterly central to a briefly prominent strain of post-Kantian philosophy. This was the short-lived school of what can be titled post-Schopenhauerian ‘omnicidal metaphysics’: a type of inverted Absolute Idealism, defined by its absolutization of cosmic terminus—

switching ‘logos’ for ‘terminus’ as world-historical motor—alongside its congruent soteriology of extinction. Now largely forgotten, such philosophy preoccupied public debate for a short-lived period. Germany, particularly, became dominated, from the 1850s onwards, by such ideas (the by-word for which became “*Weltschmerz*”). Throughout, the axiological question of human extermination was *the* impelling and gripping issue. The tradition represents a final, culminative ‘speculative abuse’ of extinction.

In 1885-6, Edgar Saltus, a now-obscure American writer published his summa on the matter, in which he attempted to baptize and consolidate a canon for this “new school” of nihilatory metaphysics across two volumes: *The Philosophy of Disenchantment* and *The Anatomy of Negation*. Claiming that “theoretic pessimism” is of “modern origin”, Saltus identifies Leopardi as its forefather and spends much time attending to Schopenhauer as its “High Priest”, yet an equally formidable portion is dedicated to the newest, and most extreme, mouthpiece of negation: Eduard von Hartmann. Therein, Saltus recounts that Hartmann goes far, far further than his forebears in his pessimist conclusions: Hartmann was “far too dramatic” to suggest “so tame” a world-historical climax as individual asceticism and abstention, since it is not only “the species” but the very “principle of existence itself [which] must be extinguished” [1885; 202].

The progeny of Schelling and Hegel as much as of Schopenhauer—whilst standing as the terminarch of their grand speculative-metaphysical tradition—Hartmann triggered Germany’s so-called ‘Pessimism Controversy’ with his *Philosophie des Unbewussten*. (‘[A]lmost forgotten today’, Hartmann was a ‘celebrity in his age’ [Beiser, 2016; 122].) Published in 1869 (four years after the first Neanderthal remains were classified as representing an extinct member of the *Homo* genus [King,

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1864]), Hartmann’s hulking volume narrates a magisterial evolutionary account of a Cosmic Unconscious’s blind self-assembly from geogony through glottogony. After volumes of scientific speculation covering topics from neuroanatomy to phylogenetics, Hartmann transitions to his “practical philosophy” for the closing few chapters.

Thoroughly teleological, the entire meaning of Hartmann’s preceding cosmogony hinges upon its final “practical” cadence. This, then, is the elucidation of history’s “*ultimate end*”: disclosed as “the goal of all intermediate ends” throughout cosmology’s grandiose development [2000; iii.120]. This “*end*” is, of course, none other than universal cosmic annihilation, consummated through humanity’s act of voluntary self-extermination. This, Hartman expatiates, is the apotheosis of *all* cosmic striving—“from the primitive cell to the origin of man”—and is the pinnacle of “*utmost world-progress*” [2000; iii.115].

Hartmann followed Schopenhauer, that is, in translating ‘existence’ as a self-cancelling contraction/contrariety and humanity as its sacrificial final-step. Nonetheless, the “tame” Schopenhauer is here criticized and duly surpassed: for this previous High Priest “conceived the problem [only] *in an individual sense*”, thusly obviating its *categorical* force. “[W]e must apprehend it *universally*”, Hartmann urges [2000; iii.132]. Indeed, he pictures to himself the Schopenhauerian scenario—of “mankind [dying] out gradually by sexual continence”—and finds it entirely lacking, concluding it would merely “perpetuate the misery of existence”.

What would it avail [if] all mankind should die out gradually[?]

[2000; iii.129]

No—this would not do—because, should this happen, the “world-process” or “Unconscious” would spit out another humanoid species to restart the process of pain again. No—*humanity must become*

the manifestation of Universal Negation within history (thus ending history from within: “coincid[ing] with the temporal end of the world-process, the last day” [iii.132]). We must become ‘ground zero’ for infinite annihilation’s entrance into finite time. Our extinction, therefore, cannot be privative: it must be superlative. We cannot go gently into the night; we must go out with a bang big enough to become self-propagating; ‘self-propagative’ in the sense that announcing the universal is never *not* ‘pandemic’. (One is shocked by how precisely Odoevsky’s ‘Last Suicide’ pre-empted Hartmann.) It cannot be an atomised abstention, but univocal and holistic self-immolation. It must, in other words, be the enunciation and enactment (thus unleashing) of something truly ‘absolute’ (for, as we know, that which is absolute *cannot but* spread). This is Hartmann’s categorical imperative: only a “*universal negation of the Will*” [2000; iii.139], he reckoned, would bring ‘into existence’ a negation so superlative as to divide total metaphysical being by zero (this, therefore, would inaugurate a truly universalizing extirpation; not the merely parochialist Schopenhauerian renunciation). In other words, we must become the world-historical incarnation of Indeterminate Negation: the intratemporal manifestation and baptism of an elimination so unalloyed that it would then consume and obviate temporal existence, *in toto*, from within. This, then, is undoubtedly a Christology, yet one where God has been transplanted with Zero and we are all the Sacrifice. (A notion extremified by Hartmann’s younger peer, Philipp Mainländer, whose *Die Philosophie der Erlösung* [1876] cast creation as divinity’s drawn-out effort to commit suicide by proxy: electing for us the sacrificial-redemptive role of finalizing the task.) Thus, the end-point of the “world-process” is “cosmic-*universal negation of the will*, as the *last moment*, after which there shall be no more volition, activity or time” [2000; iii.131]; and all purposes (all of evolution’s pretensions and projects) leading

here are retroactively revealed as nothing but colossal terminus's "proximate" and "intermediate ends". Intelligence is how nothingness, temporally, comes to know itself and know itself *as* the universe: we are the time-bound medium of the end. Philosophy, which Hartmann calls "icy cognition" as "insensitive as stone" [2000; iii.118], is the temporal unfolding of nought, as nought but the self-explication of this end, and it is the end speaking through us, as it were. "*Speak, Spirit! from thine inorganic voice*".

5—POST-MORTEM

Though Hartmann crowns this as rationality's "complete victory" [2000; iii.131], it is, by defenestrating critical limits entirely, damagingly irrational and irresponsibly incoherent. For, as ironclad fatalism, it implies we can cease observing *culpability* for our own reasonings, insofar as 'reasoning' is just *something else* articulating itself through us. All this neatly derives from the misreading of transcendental 'emptiness' endemic across post-Kantianism (Hartmann simply marks its most honest logical conclusion). Simply, when the scope of 'the transcendental' is misread as being substantive rather than exclusively normative, its lack of all empirical content—and attendant 'purity'—mutates from designating the discursive-semantic autonomy of prescriptions of 'value' from declarations of 'fact', toward instead inculcating an ontologically-inflated fealty with negativity that translates 'enlightenment' into a long-game conspiracy with our own extinction.

Due to philosophical engagement with extinction being defined, almost immediately, by such speculative excess, the issue was pronounced philosophically dead on arrival. This pronouncement came from Nietzsche, who ridiculed the tradition of 'omnicidal idealism' from Schopenhauer to Hartmann. For Nietzsche [1957; 56], the latter's sweeping vision—from "first throb of consciousness

to its final leap into nothingness”—is one “huge joke”. Nietzsche, moreover, also successfully sequestered the figure of the ‘Last Man’: demoting it from the sublime figure, steadfast in face of terminus, through which we counterfactually reflect upon the infinite culpability of our human venture, and instead deforming it into the soporific banality and eternally belated passivity of his “*Letzter Mensch*” whereby the terminus of meaning dwindles into the interminability of meaninglessness, and stratospheric stakes decay into asymptotic decline.

Nietzsche accomplished this—thus effectively exorcizing extinction as respectable philosophical topic—by turning back to the oldest trick in the book: *plenitude*. Rebranded as “*amor fati*” and “eternal return”, plenitude here no longer subordinated independent nature to judicial reason via enforcing nature’s maximal justifiability but, instead, submerged rationality within mindless nature through maximizing nature’s overflowing unjustifiabilities: existence lacks justification, yet does so maximally, such that all injustices will inevitably *be*, entailing that even the most unwarranted thought—no matter how unjustified—will eventually be *apt*. This, as a removal of all epistemic responsibility, is also yet another trivialization of the (properly existential) stakes involved in the vocation we call ‘intelligence’.

Trading ‘truth’ for ‘power’, Nietzsche excised ‘extinction’ from philosophically respectable inquiry, concomitant with establishing ‘irresponsibility’ (a.k.a. mindless difference) as a new epistemic foundation: doing so by founding maximally irrational ‘becoming’ as a new pleroma and exhorting the muscular mindlessness of its affirmation, thereby supplanting any termination of meaningful discourse with the interminability of meaningless difference.

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‘Plenitude’ was, and remains, a mightily resilient—if often unacknowledged—conviction. It survived far beyond its overtly ethico-judicial expression in Leibniz’s mantra that “*whatever is, is right*”; indeed, it found itself readily compatible with the mindless plenties presumed by post-Darwinian readings of nature. Yet, insofar as, across all its forms alike, plenitude operates by reducing *all* modal locutions to non-modal declarations, it comprehensively relinquishes the discursive tools by which we express the contingency *of* concepts themselves. Thus, whether overtly judicial or instead underwritten by voluptuous difference, plenitudinarianism entails that, in some sense, all concepts blindly *just are*, and, ergo, it aggressively *trivializes* any culpability mind holds for itself and its assertions: it absolves culpability not only in terms of our being responsible for ‘correct’ (as opposed to ‘incorrect’) beliefs, but, further, in implying that, within the widest maximalities of overflowing existence, conception is itself somehow impervious to termination. “Eternal return”, allowing no true terminus, allows no true stakes. This is why, at the opening of the twenty-first century, we must reject post-Nietzschean “*amor fati*”: even in its present-day permutation as blind enthusiasm for the ‘*posthuman-to-come*’ and unreflecting aestheticization of its ‘*acceleration*’.

Edward Nares arrogated, in 1834, “Here then is no extinction for us”. This is not so. We live in risky times—increasingly so—and increasingly so, the more we know, for knowing is risky. Extinction marks “*a very rational end of the world*”: providing ultimate expressive and pragmatic relief to reason’s committal to become culpable for itself, concordantly leaving behind all illusory foundations, whether in jurisprudential plenitude or mindless becomings. We were never “dwellers of the dwelling” (which is the self-realisation lying at the entrance of risk-oriented modernity). Yet this expatriation does not mean that our rational ends “*not [sought] in nature*” authorize us to ontologize

this “*not*”, thus casting ourselves as puppets of negation, ventriloquised by our own extinction; nor does this enable jettisoning of judicial reason’s resources when encountering nature’s utter extrajudiciality, as exemplified from Hume through Cuvier; nor, moreover, does it entitle us to recoil into blindly affirming plenistic difference, giving up critical thought in blind hope for some *post-established harmony* along the lines of Nietzsche’s eternal return or PBS’s pinioning of his utopia-to-come to tectonic cycles. On the contrary, it means precisely that we are responsible for our entire fate—from inglorious extinction to unparalleled flourishing—in the sense that it is through invoking such universalizable culpability alone that we are motivated toward ever better prediction, pre-emption, and strategizing so as to face—as a species—the challenges of a progressively riskier world. Accordingly, **should we fail, we fail only ourselves.**

BIBLIOGRAPHY

primary sources

Aeschylus, *Prometheus Bound*. trans. R. Warner (London: The Bodley Head, 1947).

anon., 'An Account of Several Systems, Particularly that of the ingenious Mr. Le Cat, with Regard to the Formation of Mountains, and the Origin of fossile Shells and Animals. from Griffiths's Nouveau Magazine Francois', in *The Monthly Review or Literary Journal*. iii (1750) pp.375-93 & pp.444-59.

anon., *Bruce's Voyage to Naples and Journey up Mount Vesuvius; giving an Account of the Strange Disaster which Happened on his Arrival at the Summit; the Discovery of the Central World* (London, 1798).

anon., 'Lectures on Comparative Anatomy by G. Cuvier, Member of the National Institute, &c.', in *The Critical Review: or, Annals of Literature* xxix (1800) pp.529-36.

anon., 'On Fossil Bones, Shelles, &c.', in *The Monthly Magazine and British Register*. xxii (1806) pp.429-30.

anon., '*The System of the World*. By P.S. Laplace, Member of the National Institute of France. Translated from the French by J. Pond, F.R.S.' in *The Edinburgh Review: or, Critical Journal* xxx (1810) pp.396-417.

anon., 'Of the End of the World', in *New Monthly & Universal Register* xi:33 (1816) pp.209-11.

anon., '*Alastor; or, The Spirit of Solitude: and Other Poems*, by Percy Bysshe Shelley', in *Blackwood's Edinburgh Magazine* xi (1819a) pp.148-154.

anon., 'Antiquarian and Philosophical Researches', in *The Gentlemen's Magazine* lxxxix (1819b) pp.541-2.

anon., 'The Last Man', in *Blackwood's Magazine* xix (1826) pp.284-86.

anon., 'The Vision of Annihilation', in *Fraser's Magazine for Town and Country* x (1834) pp.439-442.

Aquinas, T., *The Disputed Questions on Truth*. iii.vols. trans. R.W. Mulligan (Chicago: Regnery, 1952).

Aquinas, T., *Summa Theologiae: Latin Text and English Translation, Introductions, Notes, Appendices, and Glossaries*. lx.vols. ed. T.C. O'Brien (New York: McGraw-Hill, 1974).

–primary sources–

- Arago, F., *Tract on Comets: and Particularly on the Comet that is to Intersect the Earth's Path in October, 1832*. trans. J. Farrar (London, 1832).
- Arbuthnot, J., *An Essay Concerning the Effects of Air on Human Bodies* (London, 1751).
- Aristotle, *The Complete Works of Aristotle: the Revised Oxford Translation*. ii.vols. ed. J. Barnes (Princeton: Princeton University Press, 2014).
- Arnauld, A., & P. Nicole, *La logique ou l'Art de penser* (Paris, 1662).
- Augustine, *Contra Faustum Manichaeum*. ed. J. Zycha (Leipzig: G. Freytag, 1892).
- Bacon, F., 'Description of the Intellectual Globe', in *The Works of Francis Bacon*. vol.5. trans. J. Spedding. (Cambridge: Cambridge University Press, 2011).
- Bailly, J.S., *Histoire de l'astronomie ancienne, depuis son origine jusqu'à l'établissement de l'Ecole d'Alexandrie* (Paris, 1781).
- Balzac, H., *The Magic Skin, The Quest of the Absolute, and Other Stories* (Philadelphia: Avil Publishing Company, 1901).
- Baratynsky, Y.A., *A Science Not For The Earth: Selected Poems and Letters*. trans. R. Grau (Brooklyn: Inpress, 2015).
- Baratynsky, Y.A., *Half-Light and Other Poems*. trans. P. France (London: Arc, 2017).
- Barlow, J., *The Discovery of the Vital Principle, or The Physiology of Man* (London, 1838).
- Baumgarten, A.G., *Meditationes philosophicae de nonnullis ad poema pertinentibus* (Halle an der Saale, 1735).
- Bayes, T., 'An Essay towards solving a Problem in the Doctrine of Chances. By the late Rev. Mr. Bayes, communicated by Mr. Price, in a letter to John Canton, M. A. and F. R. S.', in *Phil. Trans.* liii (1763) pp.370-418.
- Beddoes, T., *The Works of Thomas Lovell Beddoes*. ed. H.W. Donner (Oxford: Oxford University Press, 1935).
- Beringer, J.B.A., *The Lying Stones of Dr. Johann Bartholomäus Beringer*. Transn. M.E. Jahn & D.J. Woolf (Berkeley: University of California Press, 1963).
- Berkeley, G., *The Works of George Berkeley Bishop of Cloyne*. 9.vols. ed. A.A. Luce & T.E. Jessop (London: Nelson, 1948-57).
- Berkeley, G., *De Motu & the Analyst: A Modern Edition, with Introduction & Commentary* (Dordrecht: Springer Publishing, 1992).

–bibliography–

- Bernoulli, J., *Conamen novi systematis cometarum* (Amsterdam, 1682).
- Bernoulli, J., *Ars conjectandi* (Basel, 1713).
- Blackstone, W., *Commentaries on the Laws of England*. iv.vols (London, 1765–1769).
- Blake, W., *Blake: The Complete Poems* (Harlow: Longman, 2007).
- Blumenbach, J.F., *Beyträge zur Naturgeschichte: erster Theil* (Göttingen, 1790).
- Boethius, *Boethius: On Aristotle, On Interpretation 1-3*. trans. A. Smith (London: Bloomsbury, 2010).
- Boutroux, C., *De la contingence des lois de la nature* (Paris, 1874).
- Breislak, S., *Introduzione alla geologia*. ii.vols (Milan, 1811).
- Broderip, W.J., ‘Dodo’, in *Penny Magazine of the Society for the Diffusion of Useful Knowledge* cxxv (1833) pp.209-11.
- Brown, T., *Observations on the Zoonomia of Erasmus Darwin M.D* (Edinburgh, 1798).
- Buckland, W., *Reliquiæ Diluvianæ: Or Observations on the Organic Remains Contained in Caves, Fissures, and Diluvial Gravel, and on Other Geological Phenomena, Attesting the Action of an Universal Deluge* (London, 1823).
- Buckland, W., *Bridgewater Treatise* (London, 1836).
- Buffon, G.L., *Histoire Naturelle, Général et Particulier*. xxxvi.vols (Paris, 1749-1788).
- Buffon, G.L., *Des Époques de la nature*, vol.v in *Histoire Naturelle, Général et Particulier* (Paris, 1778).
- Buffon, G.L., *Epochs of Nature, in Natural History, General and Particular*. ii.vols. trans. W. Wood (London, 1812).
- Buffon, G.L., *Natural History: Containing a Theory of the Earth, a General History of Man, of the Brute Creation, and of Vegetables, Minerals &c &c. from the French*. x.vols. trans. H.D. Symonds (London, 1807-15).
- Buffon, G.L., *The Epochs of Nature*. trans. J. Zalasiewicz, A. Milon & M. Zalasiewicz (Chicago: University of Chicago Press, 2018).
- Bulgarin, F., ‘Plausible Fantasies, or a Journey in the 29th Century’, in *Pre-Revolutionary Russian Science Fiction: An Anthology (Seven Utopias and a Dream)*. trans. L. Fetzer (Michigan: Arbor, 1982).

–primary sources–

- Burke, E., *Reflections on the Revolution in France*. ed. F.M. Turner (New Haven: Yale University Press, 2003).
- Burnet, T., *The Sacred Theory of the Earth: Containing an Account of the Original of the Earth, and of All the General Changes which it Hath Already Undergone, or Is to Undergo, Till the Consummation of All Things*. ii.vols (London, 1684-90).
- Burnet, T., *The Sacred Theory of the Earth* (London: Centaur Press, 1965).
- Burrit, E.H., *The Geography of the Heavens: or, Familiar Instructions for Finding the Visible Stars and Constellations accompanied by a Celestial Atlas with a View of the Solar System, Illustrated by Engravings* (Boston, 1833).
- Butler, S., *Unconscious Memory* (London, 1880).
- Byron, G.G., *Lord Byron's Cain: Twelve Essays and a Text with Variants and Annotations*. ed. T.G. Steffan (Texas: University of Texas Press, 1968).
- Byron, G.G., *The Major Works*. ed. J. Clare, E. Robinson & D. Powell (Oxford: Oxford University Press, 2008).
- Cadell, H.M., 'Experimental Researches in Mountain Building', in *Royal Society of Edinburgh Transactions* xxxv (1888) pp.337-60.
- Campbell, T., 'The Last Man', in *New Monthly Magazine* viii (1823) pp.272-3.
- Campbell, T., *Life and Letters of Thomas Campbell*. ii.vols. ed. W. Beattie (London, 1850).
- Cardano, G., *The Book on Games of Chance: the 16th-Century Treatise on Probability*. trans. S.H. Gould (New York: Dover Publications, 2015).
- Carlyle, T., 'Signs of the Times', in *Edinburgh Review* xlix (1829) pp.439-59.
- Carlyle, T., 'Speech of the Dead Christ', in *Carlyle and Jean Paul: Their Spiritual Optics*. pp.232-236 (Philadelphia: John Benjamins Publishing Company, 1982a).
- Carlyle, T., *The Correspondence of Thomas Carlyle and John Ruskin* (Stanford: Stanford University Press, 1982b).
- Carlyle, T., *Sartor Resartus* (Oxford: Oxford University Press, 2008).
- Carroll, L., *Sylvie & Bruno; Sylvie & Bruno Concluded*. ed. R. Dyer (Leicestershire: Matador, 2015).
- Casanova, G.C., *L'Icosameron*. v.vols (Prague, 1787).

—bibliography—

- Chalmers, T., 'Remarks on Cuvier's Theory of the Earth; in Extracts from a Review of that Theory which was Contributed to "The Christian Instructor" in 1814', in *Tracts and Essays, Religious and Economical by the Late Thomas Chalmers*. pp.347-72 (London, 1848).
- Chambers, R., *Vestiges of the Natural History of Creation and Other Evolutionary Writings*. ed. J.A. Secord (Chicago: University of Chicago Press, 1994).
- Chernyshevsky, N., *What Is to Be Done?* trans. M.R. Katz (Ithaca: Cornell University Press, 1989).
- Coleridge, S.T., *The Collected Works of Samuel Taylor Coleridge*. xxxiv.vols. general ed. K. Coburn. (Princeton: Princeton University Press, 1969-2002).
- Coleridge, S.T., *Marginalia*. vi.vols. ed. H.J. Jackson & G. Whalley. vol.xii in *The Collected Works of Samuel Taylor Coleridge* (Princeton: Princeton University Press, 1980-2001).
- Coleridge, S.T., *Biographia Literaria*. ii.vols. ed. W.J. Bate & J. Engell. vol.vii in *The Collected Works of Samuel Taylor Coleridge* (Princeton: Princeton University Press, 1983).
- Coleridge, S.T., *Shorter Works and Fragments*. ii.vols. ed. H.J. Jackson & J.R.J. Jackson. vol.xi in *The Collected Works of Samuel Taylor Coleridge* (Princeton: Princeton University Press, 1995).
- Coleridge, S.T., *Opus Maximum*. ed. T. MacFarland & N. Halmi. vol.xv in *The Collected Works of Samuel Taylor Coleridge* (Princeton: Princeton University Press, 2002).
- Coleridge, S.T., *The Notebooks of Samuel Taylor Coleridge*. v.vols. ed. K. Coburn & M. Christensen (London: Routledge, 1957-2002).
- Collingwood, W.G., *Life and Work of John Ruskin*. ii.vols (London, 1893).
- Creech, T., *De Rerum Natura* (London, 1682).
- Cuvier, G., *Leçons d'anatomie comparée*. v.vols (Paris, 1800-1805).
- Cuvier, G., 'Mémoire sur le squelette fossile d'un reptile volant des environs d'Aichstedt, que quelques naturalistes ont pris pour un oiseau, et don't nous formons un genre de Sauriens, sous le nom de Ptero-Dactyle', in *Annales du Muséum d'Histoire naturelle* xiii (1809) pp.424-37.
- Cuvier, G., *Reserches sur les Ossemens Fossiles de Quadrupededs*. iv.vols (Paris, 1812).
- Cuvier, G., *Recherches sur les ossemens fossiles*. v.vols (Paris, 1821-3).
- Cuvier, G., *Georges Cuvier, Fossil Bones, and Geological Catastrophes: New Translations and Interpretations of the Primary Texts*. trans. M.J.S. Rudwick (Chicago: University of Chicago Press, 2008).

–primary sources–

- Damian, P., 'The Divine Omnipotence', in *Peter Damian: Letters 91-120. The Fathers of the Church, Medieval Continuation 5*. trans. O.J. Blum. pp.344-86 (Washington: Catholic University of America Press, 1998).
- Darwin, C., *On the Origin of Species by Means of Natural Selection: Or, the Preservation of Favoured Races in the Struggle for Life* (London, 1859).
- Darwin, C., *Charles Darwin's Notebooks, 1836-1844*. ed. P.H. Barrett et al. (Ithaca: Cornell University Press, 1987).
- Darwin, E., *The Botanic Garden; a Poem, in Two Parts*. ii.vols (London, 1799).
- Darwin, E., *The Temple of Nature, or The Origin of Society* (London, 1803).
- Darwin, E., *The Botanic Garden*. ii.vols. ed. A. Komisaruk (London: Routledge, 2017).
- d'Aubuisson, J.F., *Traité De Géognosie, ou Exposé des Connaissances Actuelles sur la Constitution Physique et Minérale du Globe Terrestre* (Paris, 1819).
- Davy, H., *Consolations in Travel, or, the Last Days of a Philosopher* (London, 1830).
- De Quincey, T., 'Niles Klim, Being an Incomplete Translation from the Danish of Ludvig Holberg, Now Edited from the Manuscript by S. Musgrove', in *Auckland University College Bulletin* xlii (1953).
- De Quincey, T., 'Dream upon the Universe (trans. from J.P. Richter)', in vol.iv of *The Works of Thomas De Quincey*. ed. G. Lindop (London: Pickering & Chatto, 2003a).
- De Quincey, T., 'Age of the Earth (trans. from Immanuel Kant)', in vol.xiv of *The Works of Thomas De Quincey*. ed. G. Lindop (London: Pickering & Chatto, 2003b).
- De Quincey, T., 'System of the Heavens as Revealed by Lord Rosse's Telescopes', in vol.xv of *The Works of Thomas De Quincey*. ed. G. Lindop (London: Pickering & Chatto, 2003c).
- De Quincey, T., *The Works of Thomas De Quincey*. xxi.vols. ed. G. Lindop (London: Pickering & Chatto, 2003d).
- De Quincey, T., *Confessions of an English Opium-Eater & Related Writings*. ed. J. Faflak (Ontario: Broadview Press, 2009).
- Descartes, R., *The Philosophical Writings of Descartes*. iii.vols. trans. J. Cottingham, R. Stoothoff, D. Murdoch (Cambridge: Cambridge University Press, 1985).
- Descartes, R., *Principles of Philosophy*. trans. V.R. Miller & R.P. Miller (Dordrecht: Kluwer, 1991).
- Descartes, R., *Philosophical Essays and Correspondence* (Indianapolis: Hackett Publishing, 2000).

—bibliography—

- Diderot, D., *Lettre sur les aveugles, a l'usage de ceux qui voyent* (Paris, 1749).
- Diderot, D., *Ramaeu's Nephew / D'Alembert's Dream*. trans. L. W. Tanock (London: Penguin, 1966).
- Drummond, W., *Academical Questions* (London, 1805).
- Drummond, W., *The Œdipus Judaicus* (London, 1811a).
- Drummond, W., *Giant's Cwsauseway: A Poem* (Belfast, 1811b).
- Edgeworth, M., *Letters from England, 1813-44*. ed. C. Colvin (Oxford: Oxford University Press, 1971).
- Emerson, R.W., *Ralph Waldo Emerson: The Oxford Authors*. ed. R. Poirier (Oxford: Oxford University Press, 1990).
- Favre, A., 'The Formation of Mountains', in *Nature* xxix (1878) pp.103-6.
- Fichte, J.G., *The Vocation of Man*. P. Preuss (Indianapolis: Hackett, 1987).
- Fichte, J.G., *Introductions to the Wissenschaftslehre and Other Writings (1797-1800)*. trans. D. Breazeale (Indianapolis: Hackett, 1994).
- Fichte, J.G., *Foundations of Natural Right: According to the Principles of the Wissenschaftslehre*. trans. M. Baur (Cambridge: Cambridge University Press, 2000).
- Fichte, J.G., *The System of Ethics*. trans. D. Breazeale & G. Zöllner (Cambridge: Cambridge University Press, 2005).
- Flammarion, C., *Omega; the Last Days of the World* (London, 1894).
- Fontanelle, B., *A Plurality of Worlds*. trans. J. Glanvill (London, 1687).
- Fourier, C., *Théorie des quatre mouvements et des destinées générales* (Paris, 1808).
- Franklin, B., *Poor Richard: The Almanacs for the Years 1733-1758*. ed. N. Rockwell (New York: Heritage Press, 1964).
- Galilei, G., 'Dialogues Concerning the Two Great Systems of the World', in *Mathematical Collections and Translations, Volume 1*. trans. T. Salisbury (London, 1661).
- Galilei, G., 'Due lezioni all'accademia fiorentina circa la figura, sito e grandezza dell'Inferno di Dante', in *Scritti letterari*. ed. A. Chiari. pp.47-80 (Florence: Felice le Monnier, 1943).
- Galilei, G., *Discoveries and Opinions of Galileo: Including The Starry Messenger (1610), Letter to the Grand Duchess Christina (1615), and Excerpts from Letters on Sunspots (1613), The Assayer (1623)*. trans. S. Drake (New York: Doubleday, 1957).

—primary sources—

- Galilei, G., & C. Scheiner *On Sunspots*. trans. E. Reeves & A. van Helden (Chicago: University of Chicago Press, 2010).
- Ghazālī, A.H.M. al-, ‘The Incoherence of the Philosophers’, in *Averroës’ Tahafut al-tahafut*. trans. S.V. den Bergh (London: Luzac, 1969).
- Ghazālī, A.H.M. al-, *The Incoherence of the Philosophers: A Parallel English-Arabic Text*. trans. M.E. Marmura (Provo: Brigham Young University Press, 2000).
- Gilbert, W., *De magnete, magneticisque corporibus, et de magno magnete tellure* (London, 1600).
- Gilbert, W., *De Magnete*. trans. P.F. Mottelay (New York: Dover, 1958).
- Godwin, W., *Enquiry Concerning Political Justice*. ii.vols (London, 1798).
- Godwin, W., *Of Population: An Enquiry Concerning the Power of Increase in the Numbers of Mankind, Being an Answer to Mr Malthus’s Essay on the Subject* (London, 1820).
- Godwin, W., *Thoughts on Man, His Nature Productions, and Discoveries* (London, 1831).
- Godwin, W., *An Enquiry Concerning Political Justice* (Oxford: Oxford University Press, 2013).
- Goethe, J.W., *Scientific Studies*. vol.xii in *Goethe: The Collected Works*. ed. V. Lange et al (Berlin: Suhrkamp, 1988).
- Good, J.M., *De Rerum Natura*. ii.vols (London, 1805).
- Grainville, J-B.F.X.C., de-, *The Last Man, or Omegarus & Syderia, A Romance in Futurity*. ii.vols (London, 1806).
- Grainville, J-B.F.X.C, de-, *The Last Man: New English Translation*. ed. B. Stapleford (Connecticut: Wesleyan University Press, 2002).
- Graunt, J., *Observations Made upon the Bills of Mortality* (London: 1662).
- Green, J.H., *Vital Dynamics: The Hunterian Oration Before the Royal College of Surgeons in London, 14th February 1840* (London, 1840).
- Grosseteste, R., *De Luce* (London, 1899).
- Hall, Sir J., ‘On the Vertical Position and Convolutions of Certain Strata and their Relation with Granite’, *Royal Society of Edinburgh Transactions* vii (1815) pp.79-108.
- Halley, E., ‘A Theory of the Variation of the Magnetic Compass of the Most Ingenious Edmund Halley, Fellow of the Royal Society’, in *Phil. Trans. Of the Royal Society* xiii (1683) pp.208-20.

–bibliography–

- Halley, E., 'An Account of the Cause of the Change of the Variation of the Magnetical Needle with an Hypothesis of the Structure of the Internal Parts of the Earth', in *Phil. Trans.* xvi (1692) pp.563-87.
- Halley, E., 'Astronomiae cometicae synopsis', in *Phil. Trans.* xxiv (1705), pp.1882-99.
- Halley, E., 'A Synopsis of the Astronomy of Comets', in *Miscellanea Curiosa*. iii.vols. ed. E. Halley. pp.321-344 (London, 1706).
- Halley, E., 'Some Considerations about the Cause of the Universal Deluge, Laid Before the Royal Society, on the 12th of December 1694, By Dr. Edmond Halley, R.S.S.', in *Phil. Trans.* xxxi (1723) pp.118-26.
- Hartmann, K.R.E. von-, *Philosophie des Unbewussten* (Leipzig, 1886).
- Hartmann, K.R.E., von-, *Philosophy of the Unconscious: Speculative Results according to the Inductive Method of Physical Science*. trans. W.C. Coupland (London: Routledge, 2000).
- Harvey, W., *Exercitationes de generatione animalium* (London, 1651).
- Hawkins, T., , *Memoirs of Ichthyosauri and Plesiosauri; Extinct Monsters of the Ancient Earth, with Twenty-Eight Plates Copied from Specimens in the Author's Collection of Fossil Organic Remains* (London, 1834).
- Hegel, G.W.F., *The Logic of Hegel, Translated from the Encyclopædia of the Philosophical Sciences with Prolegomena*. trans. W. Wallace (Oxford, 1874).
- Hegel, G.W.F., *Hegel's Philosophy of Nature*. iii.vols. trans.M.J. Petry (London: George Allen & Unwin, 1970).
- Hegel, G.W.F., *Lectures on the History of Philosophy*. iii.vols (Lincoln: University of Nebraska Press, 1995).
- Herder, J.G., *Outlines of a Philosophy of the History of Man*. trans. T. Churchill (New York: Bergman, 1966).
- Herschel, J., *A Preliminary Discourse on the Study of Natural Philosophy* (London, 1830).
- Herschel, J., *Treatise on Astronomy* (London, 1833).
- Herschel, W., *The Scientific Papers of Sir William Herschel*. ii.vols (Cambridge: Cambridge University Press, 2013).
- Hesiod, *Hesiod: Theogony, Works and Days, Testimonia*. trans. G.W. Most (Massachusetts: Harvard University Press, 2006).

–primary sources–

- Hobbes, T., *Elements of Philosophy, the First Section, Concerning Body, with Six Lessons to the Professors of Mathematics* (London, 1656).
- Hogg, J., *The Pilgrims of the Sun: A Poem* (London, 1815).
- Holbach, P.T. d', *The System of Nature; or, the Laws of the Moral and Physical World*. iv.vols. trans. W. Hodgson (London, 1795-6).
- Holberg, L., *Nicolai Klimiis iter subterraneum* (Copenhagen, 1741).
- Hooke, R., 'Lectures and Discourses on Earthquakes and Subterraneous Eruptions', in *Restless Genius: Robert Hooke and his Earthly Thoughts*. ed. E.T. Drake (Oxford: Oxford University Press, 1996).
- Humboldt, A., *Cosmos: A Sketch of a Physical Description of the Universe*. ii.vols. trans. E.C. Otté (London, 1848).
- Hume, D., *An Enquiry Concerning Human Understanding; with a Letter from a Gentleman to His Friend in Edinburgh* (Indianapolis: Hackett, 1993).
- Hume, D., *A Treatise on Human Nature* (New York: Dover, 2003).
- Hume, D., 'On the Populousness of Ancient Nations', in *Writings on Economics*. trans. E. Rotwin (New Brunswick: Transaction Publishers, 2007).
- Hutton, J., *Theory of the Earth; or, an Investigation of the Laws Observable in the Composition, Dissolution and Restoration of Land upon the Globe* (Edinburgh, 1788).
- Hutton, J., *Theory of the Earth, with Proofs and Illustrations*. ii.vols (Edinburgh, 1795).
- Hutton, J., *An Investigation of the Principles of Knowledge and of the Progress of Reason, from Sense to Science and Philosophy*. iii.vols (Bristol: Thoemmes, 1999).
- Jameson, R., *Cuvier's Essay on the Theory of the Earth, with Mineralogical Notes, and an Account of Cuvier's Geological Discoveries, by Professor Jameson* (Edinburgh, 1813).
- Jefferson, T., 'A Memoir on the Discovery of Certain Bones of a Quadruped of the Clawed Kind in the Western Parts of Virginia', in *Transactions of the American Philosophical Society* iv (1799) pp.246-60.
- Jefferson, T., *The Writings of Thomas Jefferson* (Cambridge: Cambridge University Press, 2011).
- Johnson, S., *Samuel Johnson: The Oxford Authors*. ed. D.J. Greene (Oxford: Oxford University Press, 1984).
- Kant, I., *Essays and Treatises on Moral, Political, and Various Philosophical Subjects*. ii.vols (London, 1799).

–bibliography–

- Kant, I., *Kant's Cosmogony: as in His Essay on the Retardation of the Rotation of the Earth and his Natural History and Theory of the Heavens*. trans. W. Hastie (Glasgow: James Maclehose & Sons, 1900).
- Kant, I., *Gesammelte Schriften*. xxix.vols (Berlin: Walter de Gruyter, 1902-).
- Kant, I., *On History*. trans. L.W. Beck (New York: Liberal Arts Press, 1962).
- Kant, I., *The Conflict of the Faculties*. trans. M.J. Gregor (New York: Abaris Books, 1979).
- Kant, I., *Critique of Judgement*. trans. W.S. Pluhar (Indianapolis: Hackett Publishing, 1987).
- Kant, I., *Kant: Political Writings*. trans. H.B. Nisbet (Cambridge: Cambridge University Press, 1991).
- Kant, I., *Opus Postumum*. trans. E. Förster & M. Rosen (Cambridge: Cambridge University Press, 1993).
- Kant, I., *Critique of Pure Reason*. trans. A.W. Wood (Cambridge: Cambridge University Press, 1998).
- Kant, I., *Prolegomena to Any Future Metaphysics*. trans. J.W. Ellington (Indianapolis: Hackett, 2001a).
- Kant, I., *Religion and Rational Theology*. trans. A.W. Wood (Cambridge: Cambridge University Press, 2001b).
- Kant, I., *Critique of Practical Reason*. trans. W.S. Pluhar (Indianapolis: Hackett Publishing, 2002).
- Kant, I., *Metaphysical Foundations of Natural Science*. trans. M. Friedman (Cambridge: Cambridge University Press, 2004).
- Kant, I., *Anthropology from a Pragmatic Point of View*. trans. R.B. Louden (Cambridge: Cambridge University Press, 2006).
- Kant, I., *Critique of Pure Reason*. trans. M. Müller (London: Penguin, 2007).
- Kant, I., *Natural Science*. trans. E. Watkins (Cambridge: Cambridge University Press, 2012a).
- Kant, I., *Universal Natural History and Theory of the Heavens*, in *Natural Science*. trans. E. Watkins (Cambridge: Cambridge University Press, 2012b).
- Kielmeyer, C.F., *Natur und Kraft: Kielmeyer's gesammelte Schriften*. ed. F.H. Holler (Berlin: Kieper, 1938).
- Kielmeyer, C.F., *Über die Verhältnisse der organischen Kräfte unter einander in der Reihe der verschiedenen Organisationen, die Gezetze und Folgen dieser Verhältnisse* (Marburg an der Lahn: Basiliken Presse, 1993).

–primary sources–

- King, W., ‘The Reputed Fossil Man of the Neanderthal’, in *Quarterly Journal of Science* i (1864) pp.88-97.
- Kircher, A., *Mundus Subterraneus*. xii.vols (Amsterdam, 1664).
- Kircher, A., *The Vulcano’s, or, Burning and Fire-Vomiting Mountain Famous in the World: with their Remarkables, Collected for the most part out of Kircher’s Subterraneous World, and Expos’d to more General View in English* (London, 1669).
- Kölbing, E., ed., *Lord Byron’s Werke: in Kritischen Texten Mit Einleitungen und Anmerkungen*. ii.vols (Weimar: Verlag von Emil Felber, 1896).
- Lagrange, J.L., ‘Sur l’origine des comètes’, in *Journ. de Phys.* lxxiv (1812) pp.228-35.
- Lalande, J.J.F., *Réflexions sur les comètes qui peuvent approcher de la terre* (Paris, 1773).
- Lamarck, J.-B., *Zoological Philosophy*. trans. H.S.R. Elliott (Cambridge: Cambridge University Press, 2011).
- Laplace, P-S., ‘Mémoire sur la probabilité des causes par les événements’, in *Mém. Acad. Sci. Paris* vi (1774) pp.621-656.
- Laplace, P-S., ‘Mémoire sur les approximations des formules qui sont fonctions de très grands nombres’, in *Mém. Acad. Sci. Paris* (1785) pp.423-67.
- Laplace, P-S., *The System of the World*. ii.vols. trans. J. Pond. 2nd ed (London, 1809).
- Laplace, P-S., ‘Laplace’s 1774 Memoir on Inverse Probability, translated by S.M. Stigler’, in *Statistical Science* i (1986) pp.359-63.
- Lawrence, W., *An Introduction to Comparative Anatomy and Physiology; Being the Two Introductory Lectures Delivered at the Royal College of Surgeons, on the 21st and 25th of March, 1816* (London, 1816).
- Le Cat, ‘Extraits des differéns Systèmes qui paroissent depuis quelques années, sur la formation du Continent, des Montagnes, & sur l’Origine des Coquillages & des Animaux Fossiles’, in *Le Nouveau magasin François, ou bibliothèque instructive et amusante*. pp. 260-3 (London, 1750).
- Leibniz, G.W., *G.W. Leibniz’s Mondaology: A New Edition for Students*. trans. N. Rescher (Pittsburgh: University of Pittsburgh Press, 1991).
- Leibniz, G.W., *Protogaea*. trans. C. Cohen & A. Wakefield (Chicago: University of Chicago Press, 2008).

—bibliography—

- Leibniz, G.W., *Leibniz's Monadology: A New Translation and Guide*. trans. L. Stricland (Edinburgh: Edinburgh University Press, 2014).
- Lémery, N., 'Explication Physique et Chymique des Feux Souterrains, des Tremblements de Terre, des Ouragans, des Eclairs & du Tonnerre', in *Histoire de l'Académie Royale des Sciences. Année M.DCC. Avec les memoires de Mathematique & de Physique pour la meme Annee. 1700*. pp.101-110 (Paris, 1700).
- Leopardi, G., *Operette Morali: Essays and Dialogues*. trans. G. Cecchetti (Berkeley: University of California Press, 1982).
- Leopardi, G., *Canti: Poems / A Bilingual Edition*. trans. J. Galassi (New York: Farrar Straus Giroux, 2010).
- Leopardi, G., *Zibaldone*. ed M. Caeser, F. D'Intino. trans. K. Bladwin et al. (New York: Farrar Straus Giroux, 2015).
- Lermontov, M.Y., *Собрание сочинений: в четырех томах*. iv.vols. ed. I.L. Andronikov (Moscow: Chudožestvennaja Literatura, 1983-1984).
- Leslie, J., *Elements of Natural History, Volume First, Including Mechanics and Hydrostatics*. 2nd ed (Edinburgh, 1829).
- Linnaeus, C., *Systema Naturae per Regna Tria Naturae*. 12th ed (Stockholm, 1766).
- Lister, M., 'Confirmation of Mr. Rays' observations about musk scented insects, adding some notes upon Dr.Swammerdam's book of insects, and of that of Steno concerning petrified shells', in *Phil. Trans.* vi (1671) pp.2281-2284.
- Lister, M., 'A Description of Certain Stones Figured like Plants, and by Some Observing Men Esteemed to be Plants Petrified', in *Phil. Trans.* viii (1673) pp.6181-619.
- Lister, M., *Historiae Anamaliium Angliae tres Tractatus* (London, 1678).
- Locke, J., *An Essay Concerning Human Understanding* (Indianapolis: Hackett, 1996).
- Luc, J.A. de-, *An Elementary Treatise on Geology: Determining Fundamental Points in that Science, and Containing an Examination of Some Modern Geological Systems, and Particularly of the Huttonian Theory of the Earth* (London, 1809).
- Lucretius, T.C., *The Nature of Things*. trans. A.E. Stallings (London: Penguin, 2007).
- Lyell, C., *The Geological Evidences of the Antiquity of Man, with Remarks on Theories of the Origin of Species by Variation* (London, 1863).

–primary sources–

- Lyell, C., *Life, Letters, and Journals of Sir Charles Lyell, Bart, Author of 'Principles of Geology' &c, edited by his Sister-in-Law, Mrs Lyell*. ii.vols (London, 1881).
- Lyell, C., *Sir Charles Lyell's Scientific Journals on the Species Question* (New Haven: Yale University Press, 1970).
- Lyell, C., *The Principles of Geology: An Attempt to Explain the Former Changes of the Earth's Surface, By Reference to Causes now in Operation*. iii.vols (Cambridge: Cambridge University Press, 2009).
- Lynn, W.T., 'Biela's Comet', in *The Intellectual Observer; Review of Natural History, Microscopic Research, and Recreative Science, Volume XI*. pp.208-15 (London, 1867).
- Macculloch, J., 'On the Origin, Materials, Composition, and Analogies of Rocks', in *The Quarterly Journal of Science, Literature and Art* xix (1825) pp.200-12.
- Macculloch, J., *A System of Geology: with a Theory of the Earth and an Explanation of the Connexion with the Sacred Records*. ii.vols (London, 1831).
- Mackey, A.S., *The Mythological Astronomy of the Ancients Demonstrated: By Restoring to Their Fables & Symbols Their Original Meanings*. ii.vols (Norwich, 1822-3).
- Maillet, B., de-, *Telliamed, or, Conversations Between an Indian Philosopher and a French Missionary on the Diminution of the Sea* (London, 1750).
- Maillet, B. de-, *Telliamed, or, Conversations Between an Indian Philosopher and a French Missionary on the Diminution of the Sea*. trans. A.V. Carozzi (Illinois: University of Illinois Press, 1968).
- Mainländer, P., *Die Philosophie der Erlösung* (Berlin, 1876).
- Mainländer, P., *Die Philosophie der Erlösung, II* (Frankfurt, 1886).
- Mairan, J.D., 'Nouvelles recherches sur la cause générale du chaud en été et du froid en hiver, en tant qu'elle se lie à la chaleur interne et permanente de la terre', in *Mémoires Acad. Royale des Sciences* (1765) pp.143-266.
- Malfatti von Montereio, J.B., *Entwurf einer Pathogenie aus der Evolution und Revolution des Lebens* (Vienna, 1809).
- Malfatti von Montereio, J.B., *Studien über Anarchie und Hierarchie des Wissens mit besonderer Beziehung auf die Medicin* (Leipzig, 1845).
- Malthus, T., *An Essay on the Principle of Population*. ed. D. Winch (Cambridge: Cambridge University Press, 1992).
- Mantell, G.A., *The Wonders of Geology, or, A Familiar Exposition of Geological Phenomena*. ii.vols (London, 1838).

—bibliography—

- Martin, *The Young Gentleman & Lady's Philosophy in a Continued Survey of the Works of Nature and Art; by way of a Dialogue*. iii.vols (London, 1792).
- Marx, K., & F. Engels, *Marx-Engels-Werke*. xlv.vols (Berlin: Dietz Verlag, 1988).
- Mather, C., *The Christian Philosopher: A Collection of the Best Discoveries in Nature, with Religious Improvements* (London, 1721).
- Maupertuis, P.-L., *Lettre sur le comete* (Paris, 1742).
- Medwin, T., *Conversations of Lord Byron noted during a Residence with His Lordship at Pisa, in the Years 1821 and 1822* (London, 1824).
- Mercier, L.-S., *L'An 2440: Rêve s'il en fut jamais* (Paris, 1772).
- Mercier, L.-S., *Tableau de Paris* ii.vols (Neuchâtel, 1781).
- Mercier, L.-S., *Mon Bonnet De Nuit*. iv.vols (Paris, 1784).
- Mercier, L.-S., *My Night Cap*. ii.vols (London, 1785).
- Mercier, L.-S., *Memoirs of the Year Two Thousand Five Hundred*. ii.vols (Dublin, 1795).
- Mesmer, F.F.A., *Mémoire sur la découverte du magnétisme animal* (Paris, 1779).
- Milne, D., *Essay on Comets* (Edinburgh, 1828).
- Milton, J., *Milton: Paradise Lost* (Harlow: Longman, 1997).
- Milton, J., *Milton: The Complete Shorter Poems* (Harlow: Longman, 2007).
- Moivre, A. de-, *The Doctrine of Chances: or, a Method of Calculating the Probability of Events in Play* (London, 1718).
- Moivre, A. de-, *The Doctrine of Chances: or, a Method of Calculating the Probability of Events in Play, The Second Edition, Fuller, Clearer, and more Correct than the First* (London, 1738).
- Montesquieu, C., *The Spirit of the Laws*. eds. A.M. Cohler, B.C. Miller, & H.S. Stone (Cambridge: Cambridge University Press, 1989).
- Montesquieu, C., *The Persian Letters*. trans. M. Mauldon (Oxford: Oxford University Press, 2008).
- Montgomery, J., *The Pelican Island and Other Poems* (Philadelphia, 1827).
- Nares, E., *Man, as Known to us Theologically and Geologically* (London, 1834).

–primary sources–

- Newton, J.F., *The Return to Nature: or, A Defence of the Vegetable Regime; with Some Account of an Experiment Made During the Last Three of Four Years in the Author's Family* (London, 1811).
- Nicholas of Autrecourt, *Nicholas of Autrecourt, His Correspondence with Master Giles and Bernard of Arezzo: A Critical Edition and English Translation*. trans. L.M. de Rijk (Leiden: Brill Publishing, 1994).
- Nietzsche, F., *The Use and Abuse of History*. trans. A. Collins (Indianapolis: The Liberal Arts Press, 1957).
- Nietzsche, F., *Nietzsche: Writings from the Late Notebooks*. ed. R. Bittner. trans. K. Sturge (Cambridge: Cambridge University Press, 2003).
- Novalis, *Henry Von Ofterdingen*. trans. P. Hilty (Illinois: Waveland Press, 1992).
- Novalis, *Notes for a Romantic Encyclopaedia, Das Allgemeine Brouillon*. trans. D.W. Wood (Albany: State University of New York Press, 2007).
- Ockham, W., *Ockham: Philosophical Writings*. trans. P. Boehner (London: Thomas Nelson & Sons, 1957).
- Ockham, W., *Philosophical Writings: A Selection*. trans. S.F. Brown (Indianapolis: Hackett, 1990).
- Odoevsky, V.F., 'Последний человек, соч. Автора Франкенштейна. Лондон. 1826. 3 части', in *Moskovskii vestnik* iii (1827) pp.179-81.
- Odoevsky, V.F., 'The Year 4338: Letters from Petersburg', in *Pre-Revolutionary Russian Science Fiction: An Anthology (Seven Utopias and a Dream)*. trans. L. Fetzer (Michigan: Arbor, 1982).
- Odoevsky, V.F., *The Salamander and Other Gothic Tales* (Evanston: Northwestern University Press, 1992).
- Odoevsky, V.F. '4338-й год', in *Русский космизм: антология философской мысли*. ed. S.G. Semenova & A.G. Gacheva. pp.34-48 (Moscow: Nasledie, 1996).
- Odoevsky, V.F., *Russian Nights*. trans. O. Koshansky-Olienkov & R.E. Matlaw (Evanston: Northwestern University Press, 1997).
- Odoevsky, V.F., 'Two Days in the Life of the Terrestrial Globe', in *Odoevsky's Four Pathways into Modern Fiction: A Comparative Study*. trans. N. Cornwell. pp.148-54 (Manchester: Manchester University Press, 2010).
- Odoevsky, V.F., *Two Days in the Life of the Terrestrial Globe and Other Stories* (Surrey: Oneworld Classics, 2012).

—bibliography—

- Odoevsky, V.F., '4338 AD'. trans. J. Kuti (2013) available online: www.feeldothink.org/4338.htm
- Oken, L., *Elements of Physiophilosophy*. trans. A. Tulk (London, 1847).
- Olbers, H.W.M., 'Über die Möglichkeit, daß ein Komet mit der Erde zusammenstoßen könne', in *Monatliche Correspondenz zur Beförderung der Erd- und Himmelskunde* xxii (1810), pp.409-50.
- Paine, T., *Paine: Political Writings*. ed. B. Kuklick (Cambridge: Cambridge University Press, 2000).
- Parkinson, J., *Organic Remains of a Former World*. iii.vols (London, 1811).
- Parmenides, *Fragments of Parmenides: A Critical Text with Introduction and Translation, the Ancient Testimonia and a Commentary*. trans. A.H. Coxon (Las Vegas: Parmenides Publishing, 2009).
- Pascal, B., *Pensées de M. Pascal sur la religion* (Paris, 1670).
- Peacock, T.L., *Headlong Hall* (London, 1816).
- Peacock, T.L., *Melincourt*. iii.vols (London, 1817).
- Peale, R., 'A Short Account of the Mammoth', in *Philosophical Magazine* xiv (1802) pp.162-9.
- Peale, R., *Historical Disquisition on the Mammoth or Great American Incognitum* (London, 1803).
- Phillips, J., *Life on the Earth: its Origin and Succession* (Cambridge, 1816).
- Plato, *Sophist*. trans. N.P. White (Indianapolis: Hackett Publishing, 1993).
- Plato, *Protagoras, and Meno*. trans. R.C. Bartlett (Ithaca: Cornell University Press, 2004).
- Plato, *Timaeus and Critias*. trans. R. Waterfield (Oxford: Oxford University Press, 2008).
- Playfair, J., 'Transactions of the GEOLOGICAL SOCIETY, established November 1807' in *The Edinburgh Review or Critical Journal* xix (1811) pp.207-29.
- Playfair, J., *Illustrations of the Huttonian Theory of the Earth* (Cambridge: Cambridge University Press, 2011).
- Plot, R., *The Natural History of Oxfordshire* (London, 1677).
- Poe, E.A., *The Science Fiction of Edgar Allan Poe* (London: Penguin, 1976).
- Pope, A., *An Essay on Man*. ed. T. Jones (Princeton: Princeton University Press, 2016).
- Proteus, H., *Horae Canorae Subsecivae: Being the Poetical Miscellanies of Harlequin Proteus* (London, 1824).

–primary sources–

- Proteus, H., 'The World's End', in *The Imperial Magazine* vii (1825) pp.1056.
- Ray, J., *Historia Plantarum Generalis* (London, 1686).
- Ray, J., *Three Physico-Theological Discourses*. 2nd ed (London, 1693).
- Ray, J., *The Wisdom of God Manifested in the Works of Creation*, 3rd ed (London, 1701).
- Reade, J.E., *Cain the Wanderer; a Vision of Heaven; Darkness; and Other Poems*, by _____ (London, 1829).
- Redding, C., *Mount Edgcumbe: A Poem* (London, 1811).
- Redding, C., *Fifty Years 'Recollections', Literary and Personal*. iii.vols (London, 1858).
- Redding, C., *Literary Reminiscences and Memoirs of Thomas Campbell* (London, 1860).
- Reid, T., *Essays on the Intellectual Powers of Man* (London, 1785).
- Richardson, G.F., *Sketches in Prose & Verse: Containing Visits to the Mantellian Museum* (London, 1838).
- Richter, J.P., *Sämtliche Werke* (Darmstadt: Wissenschaftliche Buchgesellschaft, 1987a).
- Richter, J.P., *Siebenkäs : Blumen-, Frucht- und Dornenstücke oder Ehestand, Tod und Hochzeit d. Armenadvokaten F. St. Siebenkäs im Reichsmarktflecken Kuhschnappel* (Frankfurt: Insel-Verlag, 1987b).
- Richter, J.P., 'Speech of the Dead Christ from the Universe that There is No God', in *Jean Paul: A Reader*. trans. E. Casey. pp.179-83 (Baltimore: Johns Hopkins University Press, 1992a).
- Richter, J.P, 'Old Preface by Siebnkäs Himself', in *Jean Paul: A Reader*. trans. E. Casey. pp.196-7 (Baltimore: Johns Hopkins University Press, 1992b).
- Rosny aîné, J.-H., *The Navigators of Space: The Xipehuz, Another World, The Death of the Earth, & The Navigators of Space*. trans. B. Stapleford (Encino: Black Coat Press, 2010).
- Ruskin, J., *The Works of John Ruskin*. xxxix.vols. ed. E.T. Cook & A. Wedderburn (London: George Allen, 1903-12).
- Sade, D.A.F. de-, *Juliette* (New York: Grove/Atlantic, 1968).
- Sade, D.A.F. de-, *Justine, Philosophy in the Bedroom, and Other Writings* (New York: Grove/Atlantic, 2007).
- Saltus, E., *The Philosophy of Disenchantment* (New York, 1885).

—bibliography—

- Saltus, E., *The Anatomy of Negation* (New York, 1886).
- Sand, G., *Lélia*. trans. M. Espinosa (Bloomington: Indiana University Press, 1978).
- Sauer, M., *An Account of a Geographical & Astronomical Expedition to the Northern Parts of Russia* (London, 1802).
- Schelling, F.W.J., & J.G. Fichte, *The Philosophical Rupture between Fichte and Schelling: Selected Texts and Correspondence (1800-1802)*. trans. M.G. Vater & D.W. Wood (Albany: State University of New York Press, 2012).
- Schelling, F.W.J., *Friedrich Wilhelm Joseph von Schellings Sämmtliche Werke*. xiv.vols (Stuttgart & Ausburg, 1861).
- Schelling, F.W.J., *The Ages of the World*. trans. F.W. Bolman (New York: Columbia University Press, 1942).
- Schelling, F.W.J., *University Studies*. trans. N. Guterman (Ohio: Ohio University Press, 1966).
- Schelling, F.W.J., *System of Transcendental Idealism*. trans. M. Vater (Charlottesville: University Press of Virginia, 1978).
- Schelling, F.W.J., *The Unconditional in Human Knowledge: Four Early Essays, 1794-1796*. trans. F. Marti (Lewisburg: Bucknell University Press, 1980).
- Schelling, F.W.J., *Ideas for a Philosophy of Nature*. trans. E.E. Harris & P. Heath (Cambridge: Cambridge University Press, 1988).
- Schelling, F.W.J., *Einleitung in die Philosophie*. ed. W.E. Ehrhardt (Stuttgart: Frommann-Holzboog, 1989).
- Schelling, F.W.J., *Idealism and the Endgame of Theory: Three Essays by F.W.J. Schelling*. trans. T. Pfau (Albany: State University of New York Press, 1994a).
- Schelling, F.W.J., *On the History of Modern Philosophy*. trans. A. Bowie (Cambridge: Cambridge University Press, 1994b).
- Schelling, F.W.J., 'Ages of the World (1813)', in *The Abyss of Freedom/ Ages of the World*. trans. J. Norman (Michigan: University of Michigan Press, 1997).
- Schelling, F.W.J., *The Ages of the World*. trans. J.M. Wirth (Albany: State University of New York Press, 2000).
- Schelling, F.W.J., *First Outline of a System of the Philosophy of Nature*. trans. K.R. Peterson (Albany: State University of New York Press, 2004).

—primary sources—

- Schelling, F.W.J., *Philosophical Investigations into the Essence of Human Freedom*. trans. J. Love & J. Schmidt (Albany: State University of New York Press, 2006).
- Schelling, F.W.J., 'On the World-Soul', in *Collapse VI: Geo/philosophy*. trans. I.H. Grant. pp.66-95 (Falmouth: Urbanomic, 2010).
- Schiller, J.C.F. von-, *On the Aesthetic Education of Man: in a Series of Letters*. trans. R. Snell (New York: Dover Publications, 2004).
- Schopenhauer, A., *The World as Will and Representation*. ii.vols. trans. E.F.J. Payne (New York: Dover Publications, 1969).
- Schubert, G.H., *Anschichten von der Nachtseite der Naturwissenschaft* (Dresden, 1808).
- Scotus, D., *Philosophical Writings*. trans. A. Walter (Indianapolis: Hackett, 1987).
- Seaborn, A., *Symzonia: A Voyage of Discovery* (New York, 1820).
- Séjour, A.P.D. du-, *Essai sur les comètes en general: et particulièrement sur celles qui peuvent approcher de l'orbite de la terre* (Paris, 1775).
- Senkovsky, O.I., 'Scientific Journey to Bear Island', in *Osip Senkovsky's The Fantastic Journeys of Baron Brambeus*. trans. L. Pedrotti (New York: P. Lang, 1994).
- Shelley, M.W., *Frankenstein, or the Modern Prometheus, the 1818 version*. 2nd ed. eds. D.L. MacDonald & K. Scherf (Ontario: Broadview Press, 1999).
- Shelley, P.B., *Note Books of Percy Bysshe Shelley: From the Originals in the Library of W. K. Bixby, Deciphered, Transcribed, and Edited with a Full Commentary by H. Buxton Forman* (Boston: Bibliophile Society, 1911).
- Shelley, M.W., *Journals 1814-1844*. ii.vols. (Oxford: Clarendon Press, 1987).
- Shelley, M.W., *The Last Man*. ed. A. McWhir (Ontario: Broadview Press, 1996).
- Shelley, P.B., *The Poetical Works of Percy Bysshe Shelley*. iv.vols. ed. M.W. Shelley (London, 1839).
- Shelley, P.B., *The Prose Works of Percy Bysshe Shelley*. ii.vols. ed. R.H. Shepherd (London: Chatto & Windus, 1912).
- Shelley, P.B., *A Philosophical View of Reform* (London: Humphrey Milford, 1920).
- Shelley, P.B., *The Letters of Percy Bysshe Shelley*. ii.vols. ed. F.L. Jones (Oxford: Oxford University Press, 1964).
- Shelley, P.B., *Shelley's Prose & Poetry*. ed. D.H. Reiman & N. Fraistat (New York: W.W. Norton, 2002).

—bibliography—

- Shelley, P.B., *The Complete Poetry of Percy Bysshe Shelley*. iii.vols. ed. D.H. Reiman & N. Fraistat (Baltimore: John Hopkins University Press, 2004)
- Shelley, P.B., *The Poems of Shelley*. iv.vols. ed. K. Everest & G. Matthews (Harlow: Longman, 2010).
- Shiel, M.P., *The Purple Cloud* (London: Penguin, 2012).
- Spallanzani, L., *Tracts on the Nature of Animals and Vegetables* (Edinburgh, 1799).
- Steffens, H., *Beyträge zur innern Naturgeschichte der Erde* (Freiberg, 1801).
- Steno, N., *The Prodromus of Nicolaus Steno's Dissertation concerning a Solid Body Enclosed by Process of Nature within a Solid*. ed. J.G. Winter (London, 1915).
- Swift, J., *Gulliver's Travels* (London: Penguin, 2003).
- Tiedemann, F., & G.R. Treviranus, *Zeitschrift für Physiologie*. v.vols (1824-37).
- Tiedemann, F., *Physiologie des Menschen*. trans. J.M. Gully & J. Hunter (London, 1834).
- Volney, C-F., *A New Translation of Volney's Ruins; or, Meditations on the Revolutions of Empires* (Dublin, 1811).
- Voltaire, F.M.A., *The Philosophical Dictionary, from the French* (Glasgow, 1765).
- Voltaire, F.M.A., *Lettre sur la prétendue comète* (Paris, 1773).
- Voltaire, F.M.A., *The Elements of Sir Issac Newton's Philosophy*. trans. J. Hanna (New York: Gryphon, 1995).
- Wallace, E., *The Last Man; A Poem, in Three Cantos* (London, 1839).
- Walpole, H., *The Castle of Otranto* (Oxford: Oxford University Press, 2014).
- Whewell, W., 'Review of Lyell's *Principles of Geology*', in *The Quarterly Review* xciii (1832) pp.103-32.
- Whewell, W., *Bridgewater Treatise: Astronomy and General Physics Considered with Reference to Natural Theology* (London, 1839).
- Whewell, W., *The Philosophy of the Inductive Sciences, Founded Upon Their History*. ii.vols (London, 1840).
- Whewell, W., *The Philosophy of the Inductive Sciences, Founded Upon Their History*. 2nd ed. ii.vols (London, 1847).
- Whewell, W., *Lectures on the History of Moral Philosophy in England* (London, 1852).

–primary sources–

- Whewell, W., *The History of Scientific Ideas*. ii.vols (London, 1858).
- Whiston, W., *A New Theory of the Earth* (London, 1696).
- Willis, J., *The Universe: A Poem* (London, 1821).
- Woodward, J., *An Essay toward a Natural History of the Earth and Terrestrial Bodies, especially Minerals, and also of the Sea, Rivers, and Springs, with an Account of the Universal Deluge and of the Effects that it had upon the Earth* (London, 1695).
- Wordsworth, W., *The Prelude, 1799, 1805, 1850*. ed. J. Wordsworth, M.H. Abrams & S. Gill (New York: W.W. Norton, 1979).
- Wordsworth, W., *Poems, in Two Volumes*. ed. J. Curtis, in *The Cornell Wordsworth* (Ithaca: Cornell University Press, 1983).
- Wright, T., *An Original Theory or New Hypothesis of the Universe, Founded upon the Laws of Nature, and Solving by Mathematical Principles the General Phaenomena of the Visible Creation; and Particularly the Via Lactea* (London, 1750).
- Wright, T., *Second or Singular Thoughts upon the Theory of the Universe*. ed. M.A. Hoskin (London: Dawsons of Pall Mall, 1968).
- Wyclif, J., *On Universals*. trans. A. Kenny (Oxford: Oxford University Press, 1985a).
- Wyclif, J., *Tractatus de universalibus*. ed. I. J. Mueller, (Oxford: Oxford University Press, 1985b).
- Young, E., *Night Thoughts: Or, Night-Thoughts on Life, Death, & Immortality* (London: Dodsley, 1749).
- Zach, F., ‘Forgesetzte Nachrichten uber den neuen Haupt-Planeten unseres Sonnen-Systems, Pallas Olbersiana’ in *Monatliche Correspondenz zur Beforderung der Erd- und Himmels-Kunde* vi (1802) pp.71-96.
- Zola, E., *Germinal*. trans. P. Collier (Oxford: Oxford University Press, 1998).
- Zola, E., *The Sin of Abbé Mouret*. V. Minogue (Oxford: Oxford University Press, 2017).

secondary sources

- Abrams, M.H., *Natural Supernaturalism: Tradition and Revolution in Romantic Literature* (New York: W.W. Norton, 1971).
- Adams, F.C., 'Long-term Astrophysical Processes', in *Global Catastrophic Risks*. eds. N. Bostrom & M.M. Ćirković. pp.33-47 (Oxford: Oxford University Press, 2008).
- Adams, F.C., 'The Future History of the Universe', in *Cosmic Update: Dark Puzzles, Arrow of Time, Future History* (Dordrecht: Springer Publishing, 2012).
- Adhikari, S., & E.R. Ivins, 'Climate-Driven Polar Motion: 2003-2014', in *Science Advances* ii (2016) doi.org/10.1126/sciadv.1501693
- Adorno, T.W., & M. Horkheimer, *Dialectic of Enlightenment*. trans. E. Jephcott (Stanford: Stanford University Press, 2002).
- Alanen, L., 'Descartes, Duns Scotus, and Ockham on Omnipotence and Possibility', in *Franciscan Studies* xlv (1985) pp.157-88.
- Alanen, L., & S. Knuuttila, 'The Foundations of Modality and Conceivability in Descartes and his Predecessors', in *Modern Modalities: Studies in the History of Modal Theories from Medieval Nominalism to Logical Positivism* (Dordrecht: Kluwer, 1988).
- Alkon, P.K., *Origins of Futuristic Fiction* (Athens: University of Georgia Press, 2010).
- Allen, G., *Mary Shelley* (New York: Palgrave Macmillan, 2008).
- Almár, I., 'Analogies between Olbers' Paradox and the Fermi Paradox', in *Acta Astronaut* xxvi (1992) pp.253-6.
- Alsberg, P., *In Quest of Man: A Biological Approach to the Problem of Man's Place in Nature* (Oxford: Pergamon Press, 1970).
- Alvarez, W., *T. Rex & the Crater of Doom* (Princeton: Princeton University Press, 1997).
- Alvarez, L.W., W. Alvarez, F. Asaro, & H.V. Michel, 'Extraterrestrial Cause for the Cretaceous-Tertiary Extinction', in *Science* ccviii (1980) pp.1095-1108.
- Alvey, N.M., *Strange Truths in Undiscovered Lands: Shelley's Poetic Development and Romantic Geography* (Toronto: University of Toronto Press, 2009).
- Amador, F., 'Los "volcanes" de Nicholas Lemery (1645-1715)', in *Enseñanza de las Ciencias de la Tierra* xii (2004) pp.253-9.

—secondary sources—

- Ambrose, S.H., 'Coevolution of Composite-Tool Technology, Constructive Memory, and Language: Implications for the Evolution of Modern Human Behaviour', in *Current Anthropology* ci (2010) pp.135-47.
- Andrews, E., 'The Last Word?', in *Nature* ccclxxxi (1996) pp.272.
- Arcangeli, M., 'Thought Experiments in Model-Based Reasoning', in *The Springer Publishing Handbook of Model-Based Science*. ed. L. Magnani & T. Bertolotti. pp.891-911 (Dordrecht: Springer Publishing, 2017).
- Archibald, J.D., *Extinction and Radiation: How the Fall of the Dinosaurs Led to the Rise of the Mammals* (Baltimore: John Hopkins University Press, 2011).
- Armstrong, D.M., *What is a Law of Nature?* (Cambridge: Cambridge University Press, 1983).
- Armstrong, N., *How Novels Think: The Limits of Individualism from 1719-1900* (New York: Columbia University Press, 2006).
- Auweele, D.V., *The Kantian Foundations of Schopenhauer's Pessimism* (London: Routledge, 2017).
- Baere, B. de-, 'Natural Catastrophe in Buffon's *Histoire naturelle*: Earth, Science, Aesthetics, Anthropology', in *Histoires de la Terre*. ed. L. Lyle & D. McCallam (Amsterdam: Rodopi, 2008).
- Bailes, M., 'The Psychologisation of Geological Catastrophe in Mary Shelley's *The Last Man*', in *ELH* lxxxii (2015) pp.671-99.
- Baker, V.R., 'Catastrophism and Uniformitarianism: Logical Roots and Current Relevance in Geology', in *Geological Society of London*. cxliii (1998) pp.171-82.
- Baker, V.R., 'Charles S. Peirce and the "Light of Nature"', in *The Revolution in Geology from the Renaissance to the Enlightenment*. ed. G.R. Rosenberg. pp.259-65 (Boulder: Geological Society of America, 2009).
- Baker, V.R. ed., *Rethinking the Fabric of Geology* (Boulder: Geological Society of America, 2013).
- Bakhtin, M.M., 'Forms of Time and of the Chronotope in the Novel', in *The Dialogic Imagination: Four Essays*. trans. M. Holquist (Austin: University of Texas Press, 1981).
- Banerjee, A., *We Modern People: Science Fiction and the Making of Russian Modernity* (Connecticut: Wesleyan University Press, 2012).
- Barrow, M.V., *Nature's Ghosts: Confronting Extinction from the Age of Jefferson to the Age of Ecology* (Chicago: University of Chicago Press, 2009).

–bibliography–

- Bataille, G., *The Accursed Share: An Essay on General Economy*. ii.vols. trans. R. Hurley (New York: Zone Books, 1988-93).
- Baum, S.D., S. Armstrong, T. Ekenstedt, O. Häggström, R. Hanson, K. Kuhleman, M.M. Maas, J.D. Miller, M. Salmela, A. Sandberg, K. Sotala, P. Torres, A. Turchin, R.V. Yampolskiy, 'Long-Term Trajectories of Human Civilization', forthcoming in *Foresight*. accessed online, 01/09/2018 at - <http://gcrinstitute.org/papers/trajectories.pdf>
- Beck, M., & B. Kewell, *Risk: A Study of its Origins, History and Politics* (New Jersey: World Scientific, 2014).
- Beck, U., *Risk Society: Towards a New Modernity* (New York: SAGE Publications, 1992).
- Beck, U., *World at Risk* (New York: John Wiley & Sons, 2013).
- Beiser, F.C., *Weltschmerz: Pessimism in German Philosophy, 1860-1900* (Oxford: Oxford University Press, 2016).
- Bergman, B.P., 'The Influence of Geology in the Development of Public Health', in *A History of Geology and Medicine*. ed. C.J. Duffin et al. (Boulder: Geological Society of America, 2013).
- Bernstein, P.L., *Against the Gods: The Remarkable Story of Risk* (New York: John Wiley & Sons, 1998).
- Bersier, G., 'Visualizing Carl Friedrich Kielmeyer's Organic Forces: Goethe's Morphology on the Threshold of Evolution', in *Monatshefte*. xcvi (2005) pp.18-32.
- Bexte, P., 'Uncertainty in Grammar / The Grammar of Uncertainty: Some Remarks on the Future Perfect', in *From Science to Computational Sciences: Studies in the History of Computing & its Influence on Today's Sciences*. ed. G. Gramelsberger (Zürich: Diaphanes, 2011).
- Blanchot, M., 'Sade', in *Justine, Philosophy in the Bedroom, and Other Writings* (New York: Grove/Atlantic, 2007).
- Blanning, T., *The Culture of Power and the Power of Culture: Old Regime Europe 1660–1789* (Oxford: Oxford University Press, 2002).
- Bloch, E., *The Principle of Hope*. iii.vols (Oxford: Wiley-Blackwell, 1986).
- Blum, C., *Strength in Numbers: Population, Reproduction, and Power in Eighteenth-Century France* (Baltimore: Johns Hopkins University Press, 2002).
- Blumenberg, H., 'Kontingenz', in *Die Religion in Geschichte und Gegenwart. Handwörterbuch für Theologie und Religionswissenschaft*. ed. K. Galling (Tübingen: Mohr Siebeck, 1959).

—secondary sources—

- Blumenberg, H., *The Legitimacy of the Modern Age*. trans. R.M. Wallace (Massachusetts: Massachusetts Institute of Technology Press, 1983).
- Blumenberg, H., *Shipwreck with Spectator*. trans. S. Rendall (Massachusetts: Massachusetts Institute of Technology Press, 1996).
- Blumenberg, H., *Lebenszeit under Weltzeit* (Berlin: Suhrkamp, 2001).
- Blumenberg, H., *Paradigms for a Metaphorology*. trans. R. Savage (Ithaca: Cornell University Press, 2010).
- Bode, C., & R. Dietrich, *Future Narratives: Theory, Poetics, and Media-Historical Moment* (Berlin: Walter de Gruyter, 2013a).
- Bode, C., ‘The Probability Calculus’, in Bode, C., & R. Dietrich, *Future Narratives: Theory, Poetics, and Media-Historical Moment*. pp.168-176 (Berlin: Walter de Gruyter, 2013b).
- Bokulich, A., & N. Oreskes, ‘Models in Geosciences’, in *The Springer Publishing Handbook of Model-Based Science*. ed. L. Magnani & T. Bertolotti. pp.891-911 (Dordrecht: Springer Publishing, 2017).
- Borghini, A., *A Critical Introduction to the Metaphysics of Modality* (London: Bloomsbury, 2016).
- Bostrom, N., ‘The Doomsday Argument, Adam & Even, UN++ and Quantum Joe’, in *Synthese* cxxvii (2001) pp.359-87.
- Bostrom, N., *Anthropic Bias: Observation Selection Effects in Science and Philosophy* (London: Routledge, 2002).
- Bostrom, N., ‘Astronomical Waste: The Opportunity Cost of Delayed Technological Development’, in *Utilitas* xv (2003) pp.303-314.
- Bostrom, N., ‘The Future of Humanity’, in *New Waves in Philosophy of Technology*, eds. J.B. Olsen, E. Selinger & S. Riis. pp.186-216 (New York: Palgrave Macmillan, 2009).
- Bostrom, N., ‘Existential Risk Prevention as Global Priority’, in *Global Policy* iv (2013) pp.15-31.
- Bostrom, N., *Superintelligence: Paths, Dangers, Strategies* (Oxford: Oxford University Press, 2014).
- Bostrom, N., & M. Ćirković, *Global Catastrophic Risks* (Oxford: Oxford University Press, 2012).
- Bower, R.G., T.C.B. McLeish, B.K. Tanner, H.E. Smithson, C. Panti, N. Lewis, G.E.M. Gasper, ‘A Medieval Multiverse?: Mathematical Modelling of the Thirteenth Century Universe of Robert Grosseteste’, in *Royal Society of London Proceedings Series-A* cdlxx (2014) doi.org/10.1098/rspa.2014.0025

–bibliography–

- Bradley, M., 'Pole to Pole: Romantic Apocalypse at the Victorian *Fin de Siècle*', in *Legacies of Romanticism: Literature, Culture, Aesthetics*. eds. C. Casaliggi & P. March-Russell. pp.130-148 (London: Routledge, 2012).
- Brandom, R., *Making it Explicit: Reasoning, Representing, and Discursive Commitment* (Massachusetts: Harvard University Press, 1998).
- Brandom, R., *Articulating Reasons: An Introduction to Inferentialism* (Massachusetts: Harvard University Press, 2000).
- Brandom, R., *Tales of the Mighty Dead: Historical Essays in the Metaphysics of Intentionality* (Massachusetts: Harvard University Press, 2002).
- Brandom, R., *Reason in Philosophy: Animating Ideas* (Massachusetts: Harvard University Press, 2009).
- Brandom, R., *From Empiricism to Expressivism: Brandom Reads Sellars* (Massachusetts: Harvard University Press, 2014).
- Brandstetter, T., 'Time Machines: Model Experiments in Geology', in *Centaurus* liii (2011a) pp.135-45.
- Brandstetter, T., 'Mimetic Experiments before the Invention of the Computer', in *From Science to Computational Sciences: Studies in the History of Computing & its Influence on Today's Sciences*. ed. G. Gramelsberger (Zürich: Diaphanes, 2011b).
- Brasier, M., 'Deep Questions about the Nature of Early-Life Signals: a Commentary on Lister (1673) "A Description of Certain Stones Figured like Plants"', in *Phil. Trans.* ccclxxiii (2015) doi.org/10.1098/rsta.2014.0254
- Brasier, R., 'Solar Catastrophe: Lyotard, Freud and the Death-Drive', in *Philosophy Today* xlvii (2003) pp.421-30.
- Brasier, R., *Nihil Unbound: Enlightenment and Extinction* (New York: Palgrave Macmillan, 2006).
- Brasier, R., 'The View from Nowhere', in *Identities: Journal for Politics, Gender, and Culture* xiii (2011) pp.7-23.
- Brasier, R., 'That Which is Not: Philosophy as Entwinement of Truth and Negativity', in *Stasis* i (2013a) pp.174-86.
- Brasier, R., 'Nominalism, Naturalism, and Materialism: Sellars' Critical Ontology' in *Contemporary Philosophical Naturalism and its Implications*. Ed. B. Bashour & H. Muller (London: Routledge, 2013b).

—secondary sources—

- Brassier, R., 'Correlation, Speculation and the Modal Kant-Sellars Thesis', in *The Legacy of Kant in Sellars and Meillassoux: Analytic and Continental Kantianism*. ed. F. Gironi (London: Routledge, 2017a).
- Brassier, R., 'The Metaphysics of Sensation: Psychological Nominalism and the Reality of Consciousness', in *Wilfrid Sellars, Idealism and Realism: Understanding Psychological Nominalism*. ed. P.J. Reider (London: Bloomsbury Academic, 2017b).
- Bratton, B., *The Stack—On Software and Sovereignty* (Massachusetts: Massachusetts Institute of Technology Press, 2016).
- Brewer, W.D., *The Shelley-Byron Conversation* (Florida: University of Florida Press, 1994).
- Brush, S., *A History of Modern Planetary Physics: Nebulous Earth, the Origin of the Solar System, and the Core of the Earth from Laplace to Jeffreys* (Cambridge: Cambridge University Press, 1996).
- Burkhardt, R.W., *The Spirit of the System: Lamarck and Evolutionary Biology* (Massachusetts: Harvard University Press, 1977).
- Burnyeat, M.F., 'Idealism and Greek Philosophy: What Descartes Saw and Berkeley Missed', in *Philosophical Review* xci (1982) pp.3-40.
- Cameron, K.N., *Shelley: The Golden Years* (Massachusetts: Harvard University Press, 1974).
- Cameron, L., 'Questioning Agency: Dehumanizing Sustainability in Mary Shelley's *The Last Man*', in *Romantic Sustainability: Endurance and the Natural World, 1780-1830*. ed. B.P. Robertson (Lanham: Lexington Books, 2016).
- Cantor, P.A., 'The Apocalypse of Empire: Mary Shelley's *The Last Man*', in *Iconoclastic Departures: Mary Shelley After Frankenstein*. Ed. S.M. Conger, F.S. Frank, & G O'Dea (London: Associated University Press, 1997).
- Cardwell, R.A. ed., *The Reception of Byron in Europe*. ii.vols (London: Continuum 2004).
- Carnap, R., *Logical Syntax of Language*. trans. A. Smeaton (London: Keagan Paul, 1937).
- Carnap, R., *Foundations of Logic and Mathematics* (Chicago: Chicago University Press, 1939).
- Carnap, R., 'The Two Concepts of Probability: The Problem of Probability', in *Philosophy and Phenomenological Research* v (1945) pp.513-32.
- Carnap, R., *Logical Foundations of Probability* (Chicago: University of Chicago Press, 1950).
- Carpi, A., & A.E. Egger, *The Process of Science* (Connecticut: Visionlearning Publishing, 2011).

—bibliography—

- Carroll, V., *Science and Eccentricity: Collecting, Writing and Performing Science for Early Nineteenth-Century Audience* (London: Pickering & Chatto, 2008).
- Casaliggi, C., & P. Fermanis, *Romanticism: A Literary and Cultural History* (London: Routledge, 2016).
- Cerimonia, D., *Leopardi & Shelley: Discovery, Translation, and Reception* (Cambridge: Legenda, 2015).
- Christias, D., 'Toward the Thing-in-Itself: Sellars' and Meillassoux's Divergent Conception of Kantian Transcendentalism', in *The Legacy of Kant in Sellars & Meillassoux: Analytic & Continental Kantianism*. ed. F. Gironi (London: Routledge, 2017).
- Churchland, P., *Scientific Realism and the Plasticity of Mind* (Cambridge: Cambridge University Press, 1979).
- Ćirković, M.M., 'Observation Selection Effects and Global Catastrophic Risks', in *Global Catastrophic Risks*. eds. N. Bostrom & M.M. Ćirković. pp.120-45 (Oxford: Oxford University Press 2008).
- Ćirković, M.M., 'Fermi's Paradox: The Last Challenge to Copernicanism?', in *Serbian Astronomical Journal* clxxviii (2009a) pp.1-20.
- Ćirković, M.M., 'Astrobiological Landscape & Neocatastrophism', in *Publications of the Astronomical Observatory of Belgrade* xxcvi (2009b) pp.193-19.
- Ćirković, M.M., 'The Greatest Gamble in History', in *Collapse VIII*. pp.385-416. (Falmouth: Urbanomic, 2014).
- Ćirković, M.M., *The Great Silence: Science and Philosophy of Fermi's Paradox* (Oxford: Oxford University Press, 2018).
- Clark, A., 'Whatever next? Predictive Brains, Situated Agents, and the Future of Cognitive Science', in *Behav. Brain Sci.* xxxvi (2013) pp.181-p204.
- Clark, A., *Surfing Uncertainty: Prediction, Action and the Embodied Mind* (Oxford: Oxford University Press, 2015).
- Clarke, I.F., *The Pattern of Expectation, 1644-2001* (New York: Basic Books, 1979).
- Clarke, I.F., *The End of the World*, vol.viii in *British Future Fiction, 1700-1914* (London: Pickering & Chatto, 2001).
- Clinger, C., 'Speleological Interiority—The Mindfulness of a Spelunking Anatomist', in *Discovering the Human: Life Science and the Arts in the Eighteenth and Early Nineteenth Centuries* ed. R. Haekel & S. Blackmore (Göttingen: V&R Unipress, 2013).

—secondary sources—

- Clowes, E.W., *Fiction's Overcoat: Russian Literary Culture and the Question of Philosophy* (Ithaca: Cornell University Press, 2004).
- Cohen, C., *The Fate of the Mammoth: Fossils, Myth and History*. trans. W. Rodamor (Chicago: University of Chicago Press, 1994).
- Cole, J., *The Power of Large Numbers: Population, Politics, and Gender in Nineteenth-century France* (Ithaca: Cornell University Press, 2000).
- Coleman, W., 'Limits of the Recapitulation Theory: Carl Friedrich Kielmeyer's Critique of the Presumed Parallelism of Earth History, Ontogeny, and the Present Order of Organisms', in *Isis*. Lxiv (1973) pp.341-350.
- Coolidge, F.L., & T. Wynn, 'Working Memory, its Executive Functions, and the Emergence of Modern Thinking', in *Cambridge Archaeological Journal* xv (2005) pp.5-26.
- Cornwell, N., *Odoevsky's Four Pathways into Modern Fiction: A Comparative Study* (Manchester: Manchester University Press, 2010).
- Cornwell, N., *V.F. Odoevsky: His Life, Times and Milieu* (London: Bloomsbury, 2015).
- Cotner, S., & R. Moore, *Arguing for Evolution: An Encyclopaedia for Understanding Science* (Santa Barbara: Greenwood, 2011).
- Courtillot, V., *Evolutionary Catastrophes: The Science of Mass Extinction* (Cambridge: Cambridge University Press, 1999).
- Crowe, M.J., *The Extraterrestrial Life Debate 1750-1900: The Idea of Plurality of Worlds from Kant to Lowell* (Cambridge: Cambridge University Press, 1988).
- Cunningham, C.J., & W. Orchiston, 'Olbers's Planetary Explosion Hypothesis: Genesis and Early Nineteenth-century Interpretations', in *Journ. Hist. Astron.* xlv (2013) pp.187-206.
- Cunningham, C.J., *Discovery of the First Asteroid, Ceres: Historical Studies in Asteroid Research* (Dordrecht: Springer Publishing, 2015a).
- Cunningham, C.J., *Early Investigations of Ceres and the Discovery of Pallas: Historical Studies in Asteroid Research* (Dordrecht: Springer Publishing, 2015b).
- Cunningham, C.J., *Studies in Pallas in the Early Nineteenth-Century: Historical Studies in Asteroid Research* (Dordrecht: Springer Publishing, 2016).
- Cunningham, C.J., *Investigating the Origin of the Asteroids and Early Findings on Vesta: Historical Studies in Asteroid Research* (Dordrecht: Springer Publishing, 2017).
- Daston, L., *Classical Probability in the Enlightenment* (Princeton: Princeton University Press, 1995).

—bibliography—

- David, F.N., *Gods and Gambling: A History of Probability and Statistical Ideas* (London: Charles Griffin & Co., 1962).
- Dawson, G., *Show Me the Bone: Reconstructing Prehistoric Monsters in Nineteenth-Century Britain and America* (Chicago: University of Chicago Press, 2016).
- Dean, D.R., *James Hutton and the History of Geology* (Ithaca: Cornell University Press, 1992).
- Dean, D.R., *Gideon Mantell and the Discovery of the Dinosaurs* (Cambridge: Cambridge University Press, 1999).
- Desrosières, A., *The Politics of Large Numbers: A History of Statistical Reasoning*. trans. C. Naish (Massachusetts: Harvard University Press, 1998).
- Devlin, K., *The Unfinished Game: Pascal, Fermat, and the Seventeenth-Century Letter that Made the World Modern* (New York: Basic Books, 2010).
- Diakonova, N., & V. Vatsuro, “‘No Great Mind and Generous Heart Could Avoid Byronism’: Russia and Byron”, in *The Reception of Byron in Europe*. ii.vols. ed. R.A. Cardwell (London: Continuum 2004).
- Drake, E.T., *Restless Genius: Robert Hooke and his Earthly Thoughts* (Oxford: Oxford University Press, 1996).
- Drake, E.T., ‘Hooke’s Ideas of the Terraqueous Globe and a Theory of Evolution’, in *Robert Hooke: Tercentennial Studies*. ed. M. Cooper & M.C.W. Hunter. pp.135-152 (Burlington: Ashgate, 2006).
- Ducheyne, S., ‘Kant and Whewell on Bridging Principles Between Metaphysics and Science’, in *Kant Studien* cii (2011) pp.22-45.
- Duffy, C., *Shelley and the Revolutionary Sublime* (Cambridge: Cambridge University Press, 2005).
- Duhem, P., *La théorie physique son objet et sa structure*. 2nd ed. (Paris: Chevalier & Rivière, 1903).
- Duhem, P., *Etudes sur Léonard de Vinci*. iii.vols (Paris, 1906-1913).
- Dunham, J., & I.H. Grant & S. Watson, *Idealism: The History of a Philosophy* (Durham: Acumen Publishing, 2011).
- Eddy, M.D., ‘Photo Essay on Thomas Wright of Durham’s unpublished *New Theory of the Earth*’, in *History of Science Society Newsletter* xxxvi (2007) pp.32.
- Eiseley, L., *The Firmament of Time* (New York, Bison Books: 1999).

—secondary sources—

- Elichirigoity, F., *Planet Management: Limits to Growth, Computer Simulation, and the Emergence of Global Spaces* (Evanston: Northwestern University Press, 1999).
- Ellenberger, H.F., *The Discovery of the Unconscious* (New York: Basic Books, 1970).
- Ellis, R., *No Turning Back: The Life and Death of Animal Species* (New York: Harper Collins, 2004).
- Ellison, K.E., *Fatal News: Reading and Information Overload in Early Eighteenth-Century Literature* (London: Routledge, 2006).
- England, J., 'Statistical Physics of Adaptation', in *The Journal of Chemical Physics* cxxxix (2013) doi.org/10.1103/PhysRevX.6.021036
- Erwin, D.H., *Extinction: How Life on Earth Nearly Ended 250 Million Years Ago* (Princeton: Princeton University Press, 2006).
- Evans, J., & J.S. Rosenthal, *Probability and Statistics: The Science of Uncertainty* (New York: Infobase Publishing, 2011).
- Fehige, Y., & M.T. Stuart, 'On the Origins of the Philosophy of Thought Experiments: The Forerun', in *Perspectives on Science* xxii (2014) pp.179-220.
- Fenves, R., *Late Kant: Towards Another Law of the Earth* (London: Routledge, 2003).
- Ffytche, M., *The Foundation of the Unconscious: Schelling, Freud and the Birth of the Modern Psyche* (Cambridge: Cambridge University Press, 2012).
- Fitting, P., *Subterranean Worlds: A Critical Anthology* (Connecticut: Wesleyan University Press, 2004).
- Flechtheim, O., *History and Futurology* (Meisenheim: Verlag Anton Hain, 1966).
- Floridi, L., 'A Plea for Non-Naturalism as Constructionism', in *Minds & Machines* xxvii (2017) pp.269-85.
- Forrester, J.W., *World Dynamics* (Massachusetts: Wright-Allen Press, 1973).
- Forsström, R., *Possible Worlds: The Idea of Happiness in the Utopian Vision of Louis-Sebastien Mercier* (Helsinki: Suomalaisen Kirjallisuuden Seura, 2002).
- Foucault, M., *Society Must Be Defended: Lectures at the College de France, 1975-76*. trans. M. Bertani (London: Penguin, 2004).
- Foucault, M., *The Order of Things* (London: Routledge, 2005).
- Foucault, M., *Security, Territory, Population: Lectures at the College de France, 1977-8*. trans. G. Burchell (New York: Palgrave Macmillan, 2007).

–bibliography–

- Freud, S., *Introductory Lectures on Psycho-Analysis, Part III*. vol.xvi in *The Standard Edition of the Complete Psychological Works of Sigmund Freud*. ed. J. Strachley (London: The Hogarth Press, 1963a).
- Freud, *Beyond the Pleasure Principle*. vol.xviii in *The Standard Edition of the Complete Psychological Works of Sigmund Freud*. ed. J. Strachley (London: The Hogarth Press, 1963b).
- Funkenstein, A., *Theology and the Scientific Imagination: from the Middle Ages to the Seventeenth Century* (Princeton: Princeton University Press, 1986).
- Funkenstein, A., ‘Descartes and the Method of Annihilation’, in *Sceptics, Millenarians, and Jews*. ed. D.S. Katz & J.I. Israel (Leiden: Brill Publishing, 1990).
- Galison, P., & A. Assmus, ‘Artificial Clouds, Real Particles’, in *The Uses of Experiment: Studies in Natural Sciences*. ed. D. Gooding, T. Pinch, S. Schaffer (Cambridge: Cambridge University Press, 1989).
- Gallagher, C., *Telling it Like it Wasn't: The Counterfactual Imagination in History and Fiction* (Chicago: University of Chicago Press, 2018).
- Garland, D., ‘The Rise of Risk’, in *Risk and Morality*. ed. R.V. Ericson & A. Doyle (Toronto: University of Toronto Press, 2003).
- Gehlen, A., *Man: His Nature and Place in the World*. trans. C. McMillan & K. Pillemer (New York: Columbia University Press, 1988).
- Gelber, H.G., *It Could Have Been Otherwise: Contingency & Necessity in Dominican Theology at Oxford, 1300-1350* (Leiden: Brill Publishing, 2004).
- Genuth, S., *Comets, Popular Cosmology and the Birth of Modern Cosmology* (Princeton: Princeton University Press, 1997).
- Geric, M., ‘Shelley’s “cancelled cycles”: Huttonian Geomorphology and Catastrophe in *Prometheus Unbound*’, in *Romanticism* xix (2013) pp.31-43.
- Giddens, A., *Modernity and Self-Identity: Self and Society in the Late Modern Age* (Stanford: Stanford University Press, 1991).
- Gillespie, M.A., *Nihilism before Nietzsche* (Chicago: University of Chicago Press, 1995).
- Gironi, F., ed. *The Legacy of Kant in Sellars and Meillassoux: Analytic and Continental Kantianism* (London: Routledge, 2018).
- Givens, T., *When Souls Had Wings: Pre-Mortal Existence in Western Thought* (Oxford: Oxford University Press, 2010).

—secondary sources—

- Gleick, J., *Time Travel: A History* (London: 4th Estate, 2017).
- Gleiser, M., *The Prophet and the Astronomer: Apocalyptic Science and the End of the World* (New York: W.W. Norton, 2001).
- Goddu, A., *The Physics of William of Ockham* (Leiden: Brill Publishing, 1984).
- Gode-von Aesch, A., *Natural Science and German Romanticism* (New York: Columbia University Press, 1941).
- Godwin, J., *The Myth of the Pole in Science, Symbolism, and Nazi Survival* (Illinois: Adventures Unlimited Press, 1996).
- Gonzalez, G., D. Brownlee, & P. Ward, 'The Galactic Habitable Zone: Galactic Chemical Evolution', in *Icarus* clii (2001) pp.185-200.
- Goodall, J., & C. Knellwolf, *Frankenstein's Science: Experimentation and Discovery in Romantic Culture* (London: Ashgate, 2008).
- Gorrochurn, P., *Classic Topics on the History of Modern Mathematical Statistics: From Laplace to More Recent Times* (New York: John Wiley & Sons, 2016).
- Gottlieb, E., ed., *Global Romanticism: Origins, Orientations, and Engagements, 1760-1820* (Lewisburg: Bucknell University Press, 2015).
- Gottlieb, E., *Romantic Globalism: British Literature and Modern World Order, 1750-1830* (Ohio: Ohio State University Press, 2014).
- Gould, S.J., *Ontogeny and Phylogeny* (Massachusetts: Harvard University Press, 1977).
- Gould, S.J., *Time's Arrow, Time's Cycle: Myth and Metaphor in the Discovery of Geological Time* (Massachusetts: Harvard University Press, 1987).
- Gould, S.J., *Wonderful Life: The Burgess Shale and the Nature of History* (New York: W.W. Norton, 1989).
- Gould, S.J., *The Structure of Evolutionary Theory* (Massachusetts: Harvard University Press, 2002).
- Goulding, C., 'Shelley's Cosmological Sublime: William Herschel, James Lind and "The Multitudinous Orb"', in *The Review of English Studies* lvii (2006) pp.783-92.
- Gramelsberger, G., 'From Science to Computational Sciences: a Science History and Philosophy Overview', in *From Science to Computational Sciences: Studies in the History of Computing & its Influence on Today's Sciences*. ed. G. Gramelsberger (Zürich: Diaphanes, 2011a).
- Gramelsberger, 'Calculating the Weather: Emerging Cultures of Prediction in Late Nineteenth- and Early Twentieth-Century Europe', in *From Science to Computational Sciences: Studies in the*

–bibliography–

- History of Computing & its Influence on Today's Sciences*. ed. G. Gramelsberger (Zürich: Diaphanes, 2011b).
- Gramelsberger, G., ed. *From Science to Computational Sciences: Studies in the History of Computing & its Influence on Today's Sciences* (Zürich: Diaphanes, 2011c).
- Grant, E., *Much Ado About Nothing: Theories of Space and Vacuum from the Middle Ages to the Scientific Revolution* (Cambridge: Cambridge University Press, 1981).
- Grant, I.H., 'The Chemistry of Darkness'. in *Pli* ix (2000a) pp.36-52.
- Grant, I.H., 'Kant after Geophilosophy: The Physics of Analogy and the Metaphysics of Nature', in *The Matter of Critique: Readings in Kant's Philosophy*. pp.37-60 (Manchester: Clinamen, 2000b).
- Grant, I.H., "Philosophy Become Genetic": The Physics of the World-Soul'. in *The New Schelling*. ed. J. Norman & A. Welchman. pp.128-50 (New York: Continuum, 2004).
- Grant, I.H., *Philosophies of Nature after Schelling* (London: Continuum, 2006).
- Grant, I.H., 'Being and Slime: The Mathematics of Protoplasm in Lorenz Oken's "Physio-Philosophy"'. in *Collapse IV: Concept-Horror*. pp.286-322 (Falmouth: Urbanomic, 2008).
- Grant, I.H., 'Movements of the World: The Sources of Transcendental Philosophy', in *Analecta Hermeneutica*, iii (2011) pp.1-17.
- Grant, I.H., 'The Universe in the Universe: German Idealism and the Natural History of Mind', in *Royal Institute of Philosophy Supplement*. lxxii (2013) pp.297-316.
- Grant, I.H., 'What is an Action? Ground and Consequent in Schelling's Philosophy of Nature', in *Nature and Realism in Schelling's Philosophy*. ed. Corriero, E.C., & A. Dezi. pp.3-26 (Torino: Academia University Press, 2014).
- Greene, A., *The Death of Adam: Evolution and its Impact on Western Thought* (Iowa: Iowa State University Press, 1996).
- Greenspan, A., *Capitalism's Transcendental Time Machine*. PhD thesis. University of Warwick (2000).
- Grellard, C., 'Thought Experiments in Late Medieval Debates on Atomism', in *Thought Experiments in Methodological and Historical Contexts*. eds. K. Ierodiakonou & S. Roux (Leiden: Brill Publishing, 2011).
- Grier, D.A., 'The Early Progress of Scientific Simulation', in *From Science to Computational Sciences: Studies in the History of Computing & its Influence on Today's Sciences*. ed. G. Gramelsberger (Zürich: Diaphanes, 2011).

—secondary sources—

- Griffin, D., 'What Curiosity in the Structure: The Hollow Earth in Science', in *Between Science and Fiction: The Hollow Earth as Concept & Conceit*. ed. H. Berressem, M. Bucher, & U. Schwagmeier (Berlin: Lit Verlag, 2012).
- Griffiths, F.T., & S.J. Rabinowitz, *Novel Epics: Gogol, Dostoyevsky, and National Narrative* (Evanston: Northwestern University Press, 1990).
- Grigorian, N., 'Thought Experiments in Vladimir Odoevsky's *Russian Nights*', in *Wiener Slavistisches Jahrbuch* i (2013) pp.20-42.
- Grigorian, N., 'Thomas Malthus and Nikolai Chernyshevsky: Thought Experiments and Visions of the Future', in *What If? Preprint Series* iv (2014) <https://cms.uni-konstanz.de/fileadmin/archive/dfg-what-if/preprint-series/index.html>
- Grigorian, N., & R. Nicolosi, 'Malthusian Thought Experiments in Russian and Soviet Culture', in *What If? Preprint Series* ix (2014) <https://cms.uni-konstanz.de/fileadmin/archive/dfg-what-if/preprint-series/index.html>
- Grinnel, G., *The Age of Hypochondria: Interpreting Romantic Health and Illness* (New York: Springer Publishing, 2010).
- Groys, B., ed., *Russian Cosmism* (Massachusetts: Massachusetts Institute of Technology Press, 2018).
- Guala, F., 'Models, Simulations, and Experiments', in *Model-Based Reasoning: Science, Technology, and Values*. ed. L. Magnani & N.J. Nersessian (Dordrecht: Springer Publishing, 2001).
- Guthrie, W.K.C., *A History of Greek Philosophy*. ii.vols (Cambridge: Cambridge University Press, 1962).
- Haber, F.C., *The Age of the World: Moses to Darwin* (Baltimore: Johns Hopkins Press, 1959).
- Habermas, J., *The Structural Transformation of the Public Sphere: An Inquiry into a Category of Bourgeois Society*. trans. T. Burger & F. Lawrence (Massachusetts: Massachusetts Institute of Technology Press, 1991).
- Hacking, I., 'Jacques Bernoulli's *Art of Conjecturing*', in *The British Journal for the Philosophy of Science* xxii (1971) pp.209-229.
- Hacking, I., *The Emergence of Probability: A Philosophical Study of Early Ideas about Probability, Induction, and Statistical Inference* (Cambridge: Cambridge University Press, 1975).
- Hacking, I., *The Taming of Chance* (Cambridge: Cambridge University Press, 1990).
- Hahn, R., *Pierre Simon Laplace 1749-1827; a Determined Science* (Massachusetts: Harvard University Press, 2005).

–bibliography–

- Hald, A., *A History of Probability and Statistics and their Applications Before 1750* (New Jersey: Wiley, 2003).
- Hallam, A., *Catastrophes and Less Calamities: The Causes of Mass Extinctions* (Oxford: Oxford University Press, 2004)
- Hallam, A., & P.B. Wignall, *Mass Extinctions and their Aftermath* (Oxford: Oxford University Press, 1997).
- Halmi, N., *The Genealogy of the Romantic Symbol* (Oxford: Oxford University Press, 2007).
- Halmi, N., 'Past and Future, Discontent and Unease', in *Romanticism and the Forms of Discontent*. ed. C. Bode (Trier: Wissenschaftlicher Verlag Trier, 2017).
- Halmi, N., 'European Romanticism', in *The Cambridge History of Modern European Thought*. ii.vols. ed. P. Gordon & W. Breckman (Cambridge: Cambridge University Press, forthcoming).
- Hamacher, W., *Premises: Essays on Philosophy & Literature from Kant to Celan*. trans. P. Fenves (California: Stanford University Press, 1999).
- Hanby, M., 'Creation as Aesthetic Analogy', in *The Analogy of Being: Invention of the Antichrist or Wisdom of God?* ed. T.J. White (Michigan: William B. Eerdmans Publishing Company, 2011).
- Hanson, N.R., *Patterns of Discovery: An Inquiry into the Conceptual Foundations of Science* (Cambridge: Cambridge University Press, 1965).
- Havens, R.D., *The Mind of a Poet: A Study of Wordsworth's Thought* (Baltimore: Johns Hopkins University Press).
- Hayot, E., *On Literary Worlds* (Oxford: Oxford University Press, 2012).
- Heidarzadeh, T., *A History of Physical Theories of Comets, from Aristotle to Whipple* (Dordrecht: Springer Publishing, 2007).
- Heide, G., *Timeless Truth in the Hands of History: A Short History of System in Theology* (Oregon: Pickwick Publications, 2012).
- Heringman, N., 'The Style of Natural Catastrophe', in *Huntington Library Quarterly* lxvi (2003) pp.97-133.
- Heringman, N. *Romantic Rocks; Aesthetic Geology* (Ithaca: Cornell University Press, 2004).

—secondary sources—

- Heymann, M., G. Gramelsberger, & M. Mahony, eds., *Cultures of Prediction in Atmospheric and Climate Science: Epistemic and Cultural Shifts in Computer-based Modelling and Simulation* (London: Routledge, 2017).
- Hintikka, J., *Time and Necessity: Studies in Aristotle's Theory of Modality* (Oxford: Oxford University Press, 1973).
- Hintikka, J. 'Gaps in the Great Chain', in *Reforging the Great Chain of Being: Studies in the History of Modal Theories*. ed. S. Knuuttila. (Dordrecht: D. Reidel, 1981a).
- Hintikka, J., 'Aristotle on the Realization of Possibilities in Time', in *Reforging the Great Chain of Being: Studies in the History of Modal Theories*. ed. S. Knuuttila. (Dordrecht: D. Reidel, 1981b).
- Hintikka, J., 'Leibniz on Plenitude, Relations, and the "Reign of Law"', in *Reforging the Great Chain of Being: Studies in the History of Modal Theories*. ed. S. Knuuttila. (Dordrecht: D. Reidel, 1981c).
- Hintikka, J., & H. Kannisto, 'Kant on the Great Chain of Being', in *Reforging the Great Chain of Being: Studies in the History of Modal Theories*. ed. S. Knuuttila. (Dordrecht: D. Reidel, 1981).
- Hirvonen, V., T.J. Holopainen, & M. Tuominen, eds. *Mind and Modality: Studies in the History of Philosophy in Honor of Simo Knuuttila* (Leiden: Brill Publishing, 2006).
- Hoagwood, T.A., *Skepticism & Ideology: Shelley's Political Prose and its Philosophical Context from Bacon to Marx* (Iowa: University of Iowa Press: 1988).
- Hogle, J. E., *Shelley's Process: Radical Transference and the Development of his Major Works* (Oxford: Oxford University Press, 1988).
- Holmes, R., *Coleridge: Early Visions* (New York: Pantheon, 1999).
- Holmes, R., *Coleridge: Darker Reflections* (New York: Pantheon, 2000).
- Holmes, R., *Shelley: The Pursuit* (London: Harper, 2005).
- Holmes, R., *The Age of Wonder: How the Romantic Generation Discovered the Beauty and Terror of Science* (London: Folio Society, 2015).
- Holopainen, T.J., 'Future Contingents in the Eleventh Century', in *Mind and Modality: Studies in the History of Philosophy in Honor of Simo Knuuttila*. ed. V. Hirvonen, T.J. Holopainen, & M. Tuominen (Leiden: Brill Publishing, 2006).
- Hooykaas, R., *Natural Law and Divine Miracle: The Principle of Uniformity in Geology, Biology and Theology* (Leiden: Brill Publishing, 1963).

—bibliography—

- Hopkins, A.G., ed., *Globalization in World History* (London: Pimlico, 2002).
- Horn, E., 'The Last Man: The Birth of Modern Apocalypse in Jean Paul, John Martin, and Lord Byron', in *Catastrophes: A History and Theory of an Operative Concept*. eds. N. Lebovic & A. Killen. pp.55-74. (Berlin: Walter de Gruyter, 2014).
- Hossenfelder, S., *Lost in Math: How Beauty Leads Physics Astray* (New York: Basic Books, 2018).
- Hoyt, D.V. & K.H. Schatten, *The Role of the Sun in Climate Change* (Oxford: Oxford University Press, 1997).
- Huet, M-H., *The Culture of Disaster* (Chicago: University of Chicago Press, 2012).
- Hui, Y., 'Algorithmic Catastrophe—the Revenge of Contingency', in *Parrhesia* xxiii (2015) pp.122-43.
- Husserl, E., *The Crisis of European Sciences and Transcendental Phenomenology: An Introduction to Phenomenological Philosophy*. trans. D. Carr (Evanston: Northwestern University Press, 1970).
- Ierodiakonou, K., 'Remarks on the History of an Ancient Thought Experiment', in *Thought Experiments in Methodological and Historical Contexts*. eds. K. Ierodiakonou & S. Roux (Leiden: Brill Publishing, 2011).
- Ierodiakonou, K., & S. Roux, eds. *Thought Experiments in Methodological and Historical Contexts* (Leiden: Brill Publishing, 2011).
- Inan, İ., *The Philosophy of Curiosity* (London: Routledge, 2012).
- Jackson, F., 'A Causal Theory of Counterfactuals', in *Australian Journal of Philosophy* lv (1977) pp.3-21.
- Jaynes, E.T., *Probability Theory: The Logic of Science* (Cambridge: Cambridge University Press, 2003).
- Jessop, R., *Carlyle and Scottish Thought* (New York: Palgrave Macmillan, 1997).
- Jouvenel, B., *The Art of Conjecture*. trans. N. Lary (New York: Basic Books, 1967).
- Kahn, C.H., 'The Thesis of Parmenides', in *The Review of Metaphysics* xxii (1969) pp.700-24.
- Kapitza, S., 'A Soviet View of Nuclear Winter: International Scientific Research points to a Unanimous Conclusion, the World is too Small for Nuclear War, and the Worst-Case Scenario should be the Operational Model', in *Bulletin of the Atomic Scientists* xli (1985) pp.37-40.

—secondary sources—

- Kavanagh, J.L., S.L. Engwell, S.A. Martin, 'A Review of Laboratory and Numerical Modelling in Volcanology', in *Solid Earth* ix (2018) pp.531-71.
- Kelly, A.M., *The Discovery of Chance: The Life and Thought of Alexander Herzen* (Massachusetts: Harvard University Press, 2016).
- Kenyon Jones, C., "'When this world shall be former": Catastrophism as Imaginative Theory for the Younger Romantics', in *Romanticism on the Net* (2009) doi.org/10.7202/0060000ar
- Kermode, F., *The Sense of an Ending: Studies in the Theory of Fiction with a New Epilogue* (Oxford: Oxford University Press, 2000).
- King, A., A. Easley & J. Morton, *The Routledge Handbook of Nineteenth-Century British Periodicals and Newspapers* (London: Routledge, 2016).
- Kittler, F., 'Real Time Analysis, Time Axis Manipulation', in *Cultural Politics* xiii (2017) pp.1-18.
- Knight, F.H., *Risk, Uncertainty and Profit* (New York: Augustus M Kelley, 1964).
- Knuuttila, S., ed. *Reforging the Great Chain of Being: Studies in the History of Modal Theories* (Dordrecht: D. Reidel, 1981).
- Knuuttila, S., *Modalities in Medieval Philosophy* (London: Routledge, 1993).
- Knuuttila, S., 'Anselm & Modality', in *The Cambridge Companion to Anselm*. ed. B. Davies & B. Leftow (Cambridge: Cambridge University Press, 2004).
- Knuuttila, S., 'Medieval Modal Theories and Modal Logic', in *Handbook of the History of Logic 2: Medieval and Renaissance Logic* (Amsterdam: Elsevier, 2008).
- Knuuttila, S., & T. Kukkonen, 'Thought Experiments and Indirect Proofs in Averroes, Aquinas, & Buridan', in *Thought Experiments in Methodological and Historical Contexts*. eds. K. Ierodiakonou & S. Roux (Leiden: Brill Publishing, 2011).
- Kolbert, E., *The Sixth Extinction: An Unnatural History* (London: Bloomsbury, 2014).
- Kors, A.C., *D'Holbach's Coterie: An Enlightenment in Paris* (Princeton: Princeton University Press, 1976).
- Koselleck, R., *Future's Past: On the Semantics of Historical Time*. trans. K. Tribe (Cambridge: Cambridge University Press, 2004).
- Koyi, H., 'Analogue Modelling: From Qualitative to Quantitative Technique—A Historical Outline', in *Journal of Petroleum Geology* xx (1997) 223-38.
- Koyré, A., *The Astronomical Revolution: Copernicus, Kepler, Borelli* (New York: Dover Publications, 1992).

–bibliography–

- Krämer, S., 'Writing, Notational Iconicity, Calculus: On Writing as Cultural Technique', in *MLN* cxviii (2003) pp.418-37.
- Krämer, S., 'The Cultural Techniques of Time Axis Manipulation: on Friedrich Kittler's Conception of Media', in *Theory, Cultural & Society* xxiii (2006) pp.93-109.
- Krämer, S., 'Roots and Media of Computational Power: Some remarks on the Genesis and Genius of Quantification in Early European Modernity', in *From Science to Computational Sciences: Studies in the History of Computing & its Influence on Today's Sciences*. ed. G. Gramelsberger (Zürich: Diaphanes, 2011).
- Krauss, L.M. & G.D. Starkman, 'Life, the Universe, and Nothing: Life and Death in an Ever-Expanding Universe'. in *Astrophysics Journal*. dxxxi (2000) pp.22-30.
- Kravitz, G., 'The Thermodynamics Time Arrow and the Logical Function of the Uniformity Principle in Geohistorical Explanation', in *Rethinking the Fabric of Geology*. ed. V.R. Baker (Boulder: Geological Society of America, 2013).
- Krell, D.F., *Contagion: Sexuality, Disease, and Death in German Idealism and Romanticism* (Bloomington: Indiana University Press, 1998).
- Kuhn, T., *The Structure of Scientific Revolutions* (Chicago: University of Chicago Press, 1962).
- Kuhn, T., 'A Function for Thought Experiments', in *The Essential Tension* (Chicago: University of Chicago Press, 1977).
- Kukkonen, T., 'Possible Worlds in the *Tahâfut al-falâsifa*: Al-Gazâli on Creation and Contingency', in *Journal of the History of Philosophy* xxxviii (2000) pp.479–502.
- Kukkonen, T., 'Mind and Modal Judgement: Al-Gazâli and Ibn Rushd on Conceivability and Possibility', in *Mind and Modality: Studies in the History of Philosophy in Honor of Simo Knuuttila*. ed. V. Hirvonen, T.J. Holopainen, & M. Tuominen (Leiden: Brill Publishing, 2006).
- Kuosa, T., 'Evolution of Futures Studies', in *Futures* xliii (2011) pp.327-36.
- Lahey, S.E., *John Wyclif* (Oxford: Oxford University Press, 2009).
- Land, N., 'Odds and Ends: On Ultimate Risk', in *Collapse VIII*. pp.361-84. (Falmouth: Urbanomic, 2014).
- Laruelle, F., *Philosophies of Difference: A Critical Introduction to Non-Philosophy* (London: Continuum, 2010).
- Laruelle, F., *Dictionary of Non-Philosophy*. trans. T. Brachet (Minnesota: Univocal, 2013).

—secondary sources—

- Lauden, R., *From Minerology to Geology: The Foundations of a Science, 1650-1830* (Chicago: University of Chicago Press, 1987).
- Leakey, R., *The Sixth Extinction* (New York: Doubleday, 1995).
- Lecq, R. van der, 'Duns Scotus on the Reality of Possible Worlds', *John Duns Scotus (1265/6-1308): Renewal of Philosophy*. ed. E.P. Bos (Amsterdam: Rodopi, 1998).
- Leinkauf, T., 'Die *Centrosophia* des Athansius Kircher SJ: Geometrisches Paradigma und geozentrisches Interesse', in *Berichte zur Wissenschaftsgeschichte* xiv (1991), pp.217-229.
- Leroi-Gourhan, A., *Gesture and Speech*. trans. A.B. Berger (Massachusetts: MIT, 1993).
- Leslie, J., *The End of the World: The Science and Ethics of Human Extinction* (London: Routledge, 2002).
- Levitin, D., 'Halley and the Eternity of the World Revisited', in *Notes Rec. R. Soc.* lxvii (2013) pp.315-29.
- Lewis, D., *On the Plurality of Worlds* (Oxford: Oxford University Press, 1986).
- Lewis, D., *Counterfactuals* (Oxford: Wiley-Blackwell, 2001).
- Lomax, W., 'Epic Reversal in Mary Shelley's *The Last Man*: Romantic Irony and the Roots of Science Fiction', in *Contours of the Fantastic: Selected Essays from the Eighth International Conference on the Fantastic in the Arts*. ed. M. Langford (New York: Greenwood Press, 1990).
- Louden, B., 'Catabasis, Consulation, and the Vision', in *Home's Odyssey and the Near East* (Cambridge: Cambridge University Press, 2011).
- Louden, R.B., *Kant's Human Being: Essays on his Theory of Human Nature* (Oxford: Oxford University Press, 2014).
- Lovejoy, A., *The Great Chain of Being: A Study of the History of an Idea* (Massachusetts: Harvard University Press, 1936).
- Luhmann, N., *Risk: A Sociological Theory* (Berlin: Walter de Gruyter, 1993).
- Luhmann, N., 'Modern Society Shocked by its Risks', in *University of Hong Kong Department of Sociology Occasional Papers* xvii (1996) pp.1-19.
- Lukács, G., *The Historical Novel*. trans. H. Mitchell & S. Mitchell (Lincoln: University of Nebraska Press, 1983).
- Lupton, D., *Risk* (London: Routledge, 1999).

–bibliography–

- Lyle, L., & D. McCallam, eds. *Histoires de la Terre* (Amsterdam: Rodopi, 2008).
- Määttä, J., ‘Keeping Count of the End of the World: A Statistical Analysis of the Historiography, Canonization, and Historical Fluctuations of Anglophone Apocalyptic and Post-Apocalyptic Disaster Narratives’, in *Culture Unbound: a Journal of Current Cultural Research* vii (2015) pp.411-32.
- Mach, E., ‘Über Gedankenexperiment’, in *Z. Phys. Chem. Unterr.* xx (1896) pp.1-5.
- Magnani, L., & N. Nersessian, eds. *Model-Based Reasoning: Science, Technology, Values* (Dordrecht: Springer Publishing, 2002).
- Magnani, L., N. Nersessian, & P. Hagard, eds. *Model-Based Reasoning in Scientific Discovery* (Dordrecht: Springer Publishing, 1999).
- Magnani, L., & P. Li, eds. *Model-Based Reasoning in Science, Technology, and Medicine* (Dordrecht: Springer Publishing, 2007).
- Magnani, L., & T. Bertolotti eds. *The Springer Publishing Handbook of Model-Based Science* (Dordrecht: Springer Publishing, 2017).
- Majewski, H.F., ‘Grainville’s *Le Dernier Homme*’, in *Symposium* xvii (1963) pp.114-122.
- Majewski, H.F., ‘Mercier and the Preromantic Myth of the End of the World’, in *Studies in Romanticism* vii (1967) pp.1-14.
- Marples, M., *Romantics at School* (New York: Barnes & Noble, 1967).
- Massie, P., *Contingency, Time, and Possibility: An Essay on Aristotle and Duns Scotus* (Lanham: Lexington Books, 2001).
- Matthews, G.A., ‘A Volcano’s Voice in Shelley’, in *English Literary History* xxiv (1957) pp.191-228.
- Mauer, A., *The Philosophy of William of Ockham in the Light of its Principles* (Toronto: Pontifical Institute of Medieval studies, 1999).
- Mayer, A., ‘The Mammoth’s Part in the World’s Demise: Of the End of Humanity in Early Science Fiction’, in *Trans-Revue de literature generale et compare* xvi (2013) pp.1-13.
- Mayor, A., *The First Fossil Hunters: Palaeontology in Greek and Roman Times* (Princeton: Princeton University Press, 2000).
- McDowell, J., *Mind and World* (Massachusetts: Harvard University Press, 1994).
- McGrath, S.J., *The Dark Ground of Spirit: Schelling and the Unconscious* (London: Routledge: 2012).

—secondary sources—

- McGrayne, S.B., *The Theory That Would Not Die: How Bayes' Rule Cracked the Enigma Code, Hunted Down Russian Submarines & Emerged Triumphant from Two Centuries of Controversy* (New Haven: Yale University Press, 2011).
- McLeish, T.C.B., R.G. Bower, B.K. Tanner, H.E. Smithson, C. Panti, N. Lewis, & G.E.M. Gasper., 'History: A Medieval Multiverse', in *Nature* dvii (2014) pp.161-3.
- McPhee, J., *Basin & Range* (New York: Farrar, Straus & Girous, 1981).
- Meadows, D.H., D.L. Meadows, J. Randers, W.W. Behrens III, *The Limits to Growth: A Report for THE CLUB OF ROME'S Project on the Predicament of Mankind* (Washington: Potomac, 1972).
- Mecker, N., 'Sade at the End of the World', in *Sade's Sensibilities*. ed. K. Parker & N. Sclippa (Lewisburg: Bucknell University Press, 2015).
- Meijer, M.C., *Race and Aesthetics in the Anthropology of Petrus Camper (1722-1789)* (Amsterdam: Rodopi, 1999).
- Meillassoux, Q., *After Finitude: An Essay on the Necessity of Contingency*. trans. R. Brassier (London: Bloomsbury, 2006).
- Meillassoux, Q., 'Potentiality and Virtuality', in *Collapse II*. ed. R. Mackay. pp.55-82 (Falmouth: Urbanomic, 2007).
- Meillassoux, Q., 'Iteration, Reiteration, Repetition: A Speculative Materialist Analysis of the Sign Devoid of Meaning', in *Genealogies of Speculation*. ed. S. Malik & A. Avanesian (London: Bloomsbury, 2016).
- Merchant, C., *Autonomous Nature: Problems of Prediction and Control from Ancient Times to the Scientific Revolution* (London: Routledge, 2016).
- Mesquita, B. de-, 'Predicting the future to shape the future', in *Predicting the Future in Science, Economics, & Politics*, ed. F.W. Wayman, et al. (Cheltenham: Edward Elgar, 2014).
- Metzinger, T., *Being No One: The Self-Model Theory of Subjectivity* (Massachusetts: Massachusetts Institute of Technology Press, 2004).
- Metzinger, T., *The Ego Tunnel: The Science of Mind and the Myth of the Self* (New York: Basic Books, 2009).
- Metzinger, T., 'Suffering', in *The Return of Consciousness*. ed. K. Almqvist & A. Haag (Stockholm: Axel & Margart Ax:son Johnson Foundation, 2017a).

–bibliography–

- Metzinger, T., 'Benevolent Artificial Anti-Natalism', in *Edge* (2017b)
[https://www.edge.org/conversation/
thomas_metzinger-benevolent-artificial-anti-natalism-baan](https://www.edge.org/conversation/thomas_metzinger-benevolent-artificial-anti-natalism-baan)
- Michael, T., *British Romanticism and the Critique of Political Reason* (Baltimore: Johns Hopkins Press, 2016).
- Michelet, J., *Histoire Du XIXe Siècle, III : Jusqu'à Waterloo* (Paris: Michel Lévy, 1875).
- Miller, R., *Transforming the Future: Anticipation in the 21st Century* (London: Routledge, 2018).
- Mills, J., *Underworlds: Philosophies of the Unconscious from Psychoanalysis to Metaphysics* (London: Routledge, 2014).
- Milton, J.R., 'The Origin and Development of the Concept of the "Laws of Nature"', in *European Journal of Sociology* xxii (1981) pp.173-95.
- Mishra, V., *The Gothic Sublime* (Albany: State University of New York Press, 1994).
- Mlodinow, L., *The Drunkard's Walk: How Randomness Rules our Lives* (London: Penguin, 2009).
- Monod, J., *Chance & Necessity: An Essay on the Natural Philosophy of Modern Biology* (London: Penguin, 1997).
- Moore, G.E., *Principia Ethica* (Cambridge: Cambridge University Press, 1903).
- Morris, W.E., 'Hume's Refutation of Inductive Probabilism', in *Probability and Causality: Essays in Honor of Wesley C. Salmon*. ed. J.H. Felzer (Dordrecht: D. Reidel, 1988).
- Müller-Sievers, H., *Self-Generation: Biology, Philosophy, and Literature around 1800* (Stanford: Stanford University Press, 1997).
- Müller-Sievers, H., 'Tidings of the Earth: Towards a History of Romantic *Erdkunde*', in *Rereading Romanticism* (Amsterdam: Rodopi, 2000).
- Müller-Sievers, H., *The Science of Literature: Essays on an Incalculable Difference* (Berlin: Walter de Gruyter, 2015).
- Mumford, L., *Technics and Civilization* (New York: Harcourt, Brace & World, 1963).
- Nacol, E.C., *An Age of Risk: Politics and Economy in Early Modern Britain* (Princeton: Princeton University Press, 2016).
- Negarestani, R., *Intelligence & Spirit* (Falmouth: Urbanomic, 2018).
- Nelson, V., *The Secret Life of Puppets* (Baltimore: John Hopkins University Press, 2001).

—secondary sources—

- Nersessian, N.J., 'Model-Based Reasoning in Conceptual Change', in *Model-Based Reasoning in Scientific Discovery*. ed. Magnani, L., N. Nersessian, & P. Hagard (Dordrecht: Springer Publishing, 1999).
- Newcomb, S., *The World in a Crucible: Laboratory Practice and Geological Theory at the Beginning of Geology* (Colorado: Geological Society of America, 2009).
- Newcomb, 'Progression of Instrument use and Practice in Mineralogy and Petrology, 1750-1950', in *History of Geoscience: Celebrating 50 Years of INHIGEO*, ed. W. Mayer, R.M. Clary, L.F. Azuela, T.S. Mota & S. Wolkowicz (London: The Geological Society, 2017).
- Nicholls, A., & M. Liebscher, eds. *Thinking the Unconscious: Nineteenth-Century German Thought* (Cambridge: Cambridge University Press, 2010).
- Nicholls, A., *Myth and the Human Sciences: Hans Blumenberg's Theory of Myth* (London: Routledge, 2014).
- Niiniluoto, I., 'Probability, Possibility, and Plenitude', in *Probability and Causality: Essays in Honor of Wesley C. Salmon*. ed. J.H. Felzer (Dordrecht: D. Reidel, 1988).
- Nolan, L., ed. *Primary and Secondary Qualities: The Historical and Ongoing Debate* (Oxford: Oxford University Press, 2011).
- Normore, C.G., 'Necessity, Immutability, and Descartes', in *Mind and Modality: Studies in the History of Philosophy in Honor of Simo Knuuttila*. ed. V. Hirvonen, T.J. Holopainen, & M. Tuominen (Leiden: Brill Publishing, 2006).
- Notopoulos, J.A., *The Platonism of Shelley, A Study of Platonism and the Poetic Mind* (Durham: North Carolina, 1949).
- Novaes, C.D., 'The Different Ways in which Logic is (Said to Be) Formal', in *History and Philosophy of Logic* xxxii (2011) pp.303-32.
- Novaes, C.D., *Formal Languages in Logic: A Philosophical and Cognitive Analysis* (Cambridge: Cambridge University Press, 2012).
- Nusbaum, F.A., 'Introduction', in *The Global Eighteenth Century*. ed. F.A. Nussbaum (Baltimore: Johns Hopkins University Press, 2003).
- O'Connor, R., *The Earth on Show: Fossils and the Poetics of Popular Science, 1802-1856* (Chicago: University of Chicago Press, 2007).
- O'Shea, J., *Wilfrid Sellars: Naturalism with a Normative Turn* (Cambridge: Polity, 2015).
- Oakley, F., 'Christian Theology and the Newtonian Science: The Rise of the Concept of the Laws of Nature', in *Church History* xxx (1961) pp.433-57.

—bibliography—

- Oakley, F., *Natural Law, Laws of Nature, Natural Rights: Continuity and Discontinuity in the History of Ideas* (New York: Continuum, 2005).
- Oerlemans, O., *Romanticism and the Materiality of Nature* (Toronto: University of Toronto Press, 2002).
- Ore, O., *Cardano: the Gambling Scholar* (Princeton: Princeton University Press, 1953).
- Oreskes, N., 'From Scaling to Simulation: Changing Meanings and Ambitions of Models in the Earth Sciences', in *Science Without Laws: Model Systems, Cases, and Exemplary Narratives*. ed. A. Creager, E. Lunbeck, & M.N. Wise. pp.93-124 (Durham: Duke University Press, 2007)
- Page, M.R., *The Literary Imagination from Erasmus Darwin to H.G. Wells: Science, Evolution and Ecology* (London: Routledge, 2012).
- Paley, M.D., 'Mary Shelley's *The Last Man*: Apocalypse without Millenium', in *The Keats-Shelley Review*, iv (1989) pp.1-25.
- Paley, M.D., '*Le dernier homme*: The French Revolution as the Failure of Typology', in *Mosaic* xx (1991) pp.66-76.
- Parejko, 'Pliny the Elder's *Silphium*: First Recorded Species Extinction', in *Convervation Biology*. xvii (2003) pp.925-7.
- Parish, J.C., *The Dodo and the Solitaire: A Natural History* (Bloomington: Indiana University Press, 2013).
- Peirce, C., *Philosophical Writings of Peirce* (New York: Dover, 1955).
- Perszyk, K.J., *Nonexistent Objects: Meinong and Contemporary Philosophy* (Dordrecht: Kluwer, 1993).
- Pettman, D., *After the Orgy: Towards a Politics of Exhaustion* (Albany: State University of New York Press, 2002).
- Philipp, S., 'Contingency', in *Religion Past & Present*. ed. H.D. Betz (Leiden: Brill Publishing, 2007).
- Platthaus, I., 'Outside Turned Inside: Heaven and the Underworld in the Conception of the Hollow Earth from Dante to Tarzan', in *Between Science and Fiction: The Hollow Earth as Concept & Conceit*. ed. H. Berressem, M. Bucher, & U. Schwagmeier (Berlin: Lit Verlag, 2012).
- Poole, R., *Earthrise: How Man First Saw the Earth* (New Haven: Yale University Press, 2008).
- Poole, W., *The World Makers: Scientists of the Restoration and the Search for the Origins of the Earth* (Oxford: Peter Lang, 2010).

—secondary sources—

- Poser, H., 'The Failure of Logical Positivism to Cope with Problems of Modal Theory', in *Modern Modalities: Studies in the History of Modal Theories from Medieval Nominalism to Logical Positivism* (Dordrecht: Kluwer, 1988).
- Pratt, M.L., *Imperial Eyes: Travel Writing and Transculturation* (London: Routledge, 2007).
- Quine, W.V.O., 'On What There Is', in *The Review of Metaphysics* ii (1948) pp.21-38.
- Rabinbach, A., *The Human Motor: Energy, Fatigue, and the Origins of Modernity* (Berkeley: University of California Press, 1992).
- Rajan, T., *Dark Interpreter: The Discourse of Romanticism* (Ithaca: Cornell University Press, 1980).
- Rajan, T., 'Between Romance and History: Possibility and Contingency in Godwin, Leibniz, and Mary Shelley's *Valperga*', in *Mary Shelley and her Times*. ed. B.T. Bennett & S. Curran (Baltimore: Johns Hopkins University Press, 2000).
- Rajan, T., 'The Unavowable Community of Idealism: Coleridge and the Life Sciences', in *European Romantic Review* xiv (2003) pp.395-416.
- Rajan, T., 'The Abyss of the Past: Psychoanalysis in Schelling's *Ages of the World* (1815)', in *Romantic Psyche and Psychoanalysis*. ed. J. Faflak (2008)
www.rc.umd.edu/praxis/psychoanalysis/index.html
- Rajan, T., 'The Psychoanalytic Turn of Idealism: Friedrich Schelling's *The Ages of the World* (1815)', in *Romanticism Today*. ed. L. Eckstein & C. Reinfandt (Trier: Wissenschaftliche Verlag, 2009).
- Rajan, T., 'The Life of the "Idea": Hegel, Schelling, and Schopenhauer', in *Pli: Warwick Journal of Philosophy* xxvi (2014) pp.27-48.
- Ramachandran, A., *The Worldmakers: Global Imagining in Early Modern Europe* (Chicago: University of Chicago Press, 2015).
- Ramsey, F.P., 'Truth and Probability', in *The Foundations of Mathematics and Other Logical Essays*. ed. R.B. Braithwhite (London: K. Paul, Trench, Truber & co., 1931).
- Ranalli, G., 'Experimental Tectonics: From Sir James Hall to the Present', in *Journal of Geodynamics* xxxii (2001) pp.65-76.
- Rantanen, T., *The Media and Globalization* (New York: SAGE Publications, 2005).
- Rantanen, T., *When News Was New* (Oxford: Wiley-Blackwell, 2009).
- Raup, D.M., & J.J. Sepkoski, 'Periodicity of Extinctions in the Geologic Past', in *Proc. Nat. Acad. Sci. USA*, xxci (1984) pp.801-5.

—bibliography—

- Raup, D.M., *Extinction: Bad Genes or Bad Luck?* (New York: W.W. Norton, 1991).
- Raup, D.M., *The Nemesis Affair: A Story of the Death of Dinosaurs and the Ways of Science*. 2nd ed (New York: W.W. Norton, 1999).
- Redfield, M., 'Wordsworth's Dream of Extinction', in *Qui Parle* xxi (2013) pp.61-8.
- Redford, C., 'The Last Man and Romantic Archaeology', in *Grasmere, 2012: Selected Papers from the Wordsworth Summer Conference*, ed. Richard Grivil. pp.160-70 (Penrith: HEB-Humanities, 2012).
- Rees, M., *Our Final Hour: A Scientist's Warning, How Terror Error, and Environmental Disaster Threaten Humankind's Future in This Century—on Earth and Beyond* (New York: Basic Books, 2003).
- Reeves, E., 'Reading Maps', in *Word & Image* ix (1993) 51-65.
- Regier, A., 'Forces Trembling Underneath: The Lisbon Earthquake and the Sublime', in *Fracture and Fragmentation in British Romanticism* (Cambridge: Cambridge University Press, 2010).
- Rehbock, P.F., 'John Fleming (1787-1857) and the Economy of Nature', in *From Linnaeus to Darwin: Commentaries on the History of Biology and Geology, Papers from the Fifth Easter Meeting of the Society for the History of Natural History*. eds. A.C. Wheeler & J. Price (London: Society for the History of Natural History, 1985).
- Reid, N., 'The Satanic Principle in the Later Coleridge's Theory of Imagination', in *Studies in Romanticism* xxxvii (1998) pp.259-77.
- Reisner, T.A., 'Some Scientific Models for Shelley's Multitudinous Orb', in *Keats-Shelley Journal* xxiii (1974), pp.52-59.
- Rescher, N., *Predicting the Future: An Introduction to the Theory of Forecasting* (Albany: State University of New York Press, 1998).
- Rescher, N., *Imagining Irreality: A Study of Unreal Possibilities* (Chicago: Carus Verlag, 2003).
- Rigby, K., *Topographies of the Sacred: The Poetics of Place in European Romanticism* (Charlottesville: University of Virginia Press, 2004).
- Riker, S., 'al-Ghazālī on Necessary Causality in "The Incoherence of the Philosophers"', in *The Monist* lxxix (1996) pp.315-24.
- Roberts, C., *The Unnatural History of the Sea* (Washington: Island Press, 2007).
- Roberts, H., *Shelley and the Chaos of History: A New Politics of Poetry* (Pennsylvania: The Pennsylvania State University Press, 1997).

—secondary sources—

- Robertson, R., *Globalization: Social Theory and Global Culture* (New York: SAGE Publications, 1992).
- Roger, J., *Buffon: A Life in Natural History*. trans. S.L. Bonnefoi (Ithaca: Cornell University Press, 1997)
- Rohr, C., 'Man and Natural Disaster in the Late Middle Ages: The Earthquake in Carinthia and Northern Italy on 25 January 1348 and its Perception', in *Environment and History* ix (2003) pp.127-49.
- Rohr, M., 'Empty Forms in Plato', in *Reforging the Great Chain of Being: Studies in the History of Modal Theories*. ed. S. Knuuttila. pp.207-26. (Dordrecht: D. Reidel, 1981).
- Rolfe, W.D., 'William and John Hunter: Breaking the Great Chain of Being', in *William Hunter and the Eighteenth-Century Medical World*. eds. W. Bynum & R. Porter. pp.297-320 (Cambridge: Cambridge University Press, 1985).
- Ronen, R., *Possible Worlds in Literary Theory* (Cambridge: Cambridge University Press, 2008).
- Roos, A.M., *Web of Nature: Martin Lister (1639-1712), the First Arachnologist* (Leiden: Brill Publishing, 2011).
- Rosen, F., 'The Principle of Population as Political Theory: Godwin's *Of Population* and the Malthusian Controversy', in *Journal of the History of Ideas*. xxxi (1970) pp.33-48.
- Rosen, R., *Anticipatory Systems: Philosophical, Mathematical, and Methodological Foundations* (Dordrecht: Springer Publishing, 2012).
- Rosendahl, W., & S. Kempe, & D. Doppes, 'The Scientific Discovery of the *Ursus spelaeus*', in *Naturhistorische Gesellschaft Nürnberg* xlv (2005) pp.191-8.
- Ross, S., 'Scientist: The Story of a Word', in *Annals of Science* xviii (1962) pp.65-85.
- Rossi, P., *The Dark Abyss of Time: The History of the Earth and the History of Nations from Hooke to Vico*. trans. L.G. Cochrane (Chicago: University of Chicago Press, 1987).
- Rothe, D., 'Seeing like a Satellite: Remote Sensing and the Ontological Politics of Environmental Security', in *Security Dialogue* xlvi (2017) pp.334-53.
- Roux, S., 'Introduction: The Emergence of the Notion of Thought Experiments', in *Thought Experiments in Methodological and Historical Contexts*. eds. K. Ierodiakonou & S. Roux (Leiden: Brill Publishing, 2011).
- Rowland, 'Thomas Jefferson, Extinction, and the Evolving View of Earth History in the Late Eighteenth and Early Nineteenth Centuries', in *The Revolution in Geology from the*

–bibliography–

- Renaissance to the Enlightenment*. ed. G.D. Rosenberg. pp.225-46 (Colorado: Geological Society of America, 2009).
- Rubenstein, M-J., *Worlds Without End: The Many Lives of the Multiverse* (New York: Columbia University Press, 2014).
- Rudolf, A., *Byron's 'Darkness': Lost Summer and Nuclear Winter* (London: Menard Press, 1984).
- Rudwick, M.J.S., *The Meaning of Fossils: Episodes in the History of Palaeontology* (Chicago: University of Chicago Press, 1972).
- Rudwick, M.J.S., 'Caricature as a Source for the History of Science: De la Beche's Anti-Lyellian Sketches of 1831', in *Isis* lxvi (1975) pp.534-60.
- Rudwick, M.J.S., *Scenes from Deep Time: Early Pictorial Representations of the Prehistoric World* (Chicago: University of Chicago Press, 1992).
- Rudwick, M.J.S., *Bursting the Limits of Time: The Reconstruction of Geohistory in the Age of Revolution* (Chicago: University of Chicago Press, 2005).
- Rudwick, M.J.S., *Worlds Before Adam: The Reconstruction of Geohistory in the Age of Reform* (Chicago: University of Chicago Press, 2008).
- Rudwick, M.J.S., *Georges Cuvier, Fossil Bones, and Geological Catastrophes: New Translations and Interpretations of the Primary Texts*. (Chicago: University of Chicago Press, 2008).
- Rudwick, M.J.S., *Earth's Deep History: How it was Discovered and Why it Matters* (Chicago: University of Chicago Press, 2014).
- Schaffer, S., 'Halley's Atheism and the End of the World'. in *Notes Rec. R. Soc.* xxxii (1997) pp.17-40.
- Schama, S., *Citizens: A Chronical of the French Revolution* (London: Vintage Books, 1990).
- Schrempp, G., 'Copernican Kinship: An Origin Myth for the Category', in *Journal of Ethnographic Theory* xi (2011) pp.103-39.
- Scott, H.C.M., 'Apocalypse Narrative, Chaotic System: Gilbert White's *Natural History of Selborne* and Modern Ecology' in *Romanticism and Victorianism on the Net* cvi (2009)
<http://id.erudit.org/iderudit/1001095ar>
- Scott, H.C.M., *Chaos and Cosmos: Literary Roots of Modern Ecology in the British Nineteenth-Century* (Pennsylvania: Pennsylvania State University Press, 2014).

—secondary sources—

- Sellars, W., 'Counterfactuals, Dispositions, and the Causal Modalities', in *Minnesota Studies in the Philosophy of Science, Vol.II*. ed. H. Feigl, M. Scriven, & G. Maxwell. pp.225-308 (Minneapolis: University of Minneapolis Press, 1957).
- Sellars, W., 'Philosophy and the Scientific Image of Man' in *Frontiers of Science and Philosophy*. ed. R. Colodny (Pittsburgh: University of Pittsburgh Press, 1962).
- Sellars, W., 'Abstract Entities', in *Review of Metaphysics* xvi (1963) pp.627-71.
- Sellars, W., 'Some Remarks on Kant's Theory of Experience', in *Journal of Philosophy* lxi (1967) pp.633-47.
- Sellars, W., 'Towards a Theory of the Categories', in *Experience and Theory*. ed. L. Foster & J.W. Swanson. pp.55-78 (Cambridge: University of Massachusetts Press, 1970).
- Sellars, W., *Empiricism & the Philosophy of Mind*. ed. R. Rorty & R. Brandom (Massachusetts: Harvard University Press, 1997).
- Sellars, W., *In the Space of Reasons: Selected Essays of Wilfrid Sellars*. ed. K. Scharp & R.B. Brandom (Massachusetts: Harvard University Press, 2007).
- Semonin, P., *American Monster: How the Nation's First Prehistoric Creature Became a Symbol of National Identity* (New York: New York University Press, 2009).
- Şengör, C., & S. Atayman, *The Permian Extinction and the Tethys: An Exercise in Global Geology* (Boulder: The Geological Society of America, 2009).
- Signor, P.W., & J.H. Lipps, 'Sampling Bias, Gradual Extinction Patterns, and Catastrophes in the Fossil Record', in *Geological Implications of Large Asteroids and Comets on the Earth*. ed. L.T. Silver & P.T. Schultz (Boulder: Geological Society of America, 1982).
- Sims, G., *Unhomely Nature: Inorganicist Philosophy in Giacomo Leopardi's Poetry & Prose*. PhD thesis. New York University (2012).
- Singler, B., 'Roko's Basilisk or Pascal's? Thinking of Singularity Thought Experiments as Implicit Religion', in *Implicit Religion* xx (2018) pp.279-97.
- Sinnema, P.W., "'We have Adventured to Make the Earth Hollow": Edmond Halley's Extravagant Hypothesis', in *Perspectives on Science* xxii (2014) pp.423-48.
- Sloterdijk, P., *Spheres, Vol. I, Bubbles: Microspherology* (Los Angeles: Semiotext(e), 2011).
- Sloterdijk, P., *Spheres, Vol.II, Globes: Macrospherology* (Los Angeles: Semiotext(e), 2014).
- Smolin, L., *Time Reborn: From the Crisis in Physics to the Future of the Universe* (Boston: Houghton Mifflin Harcourt, 2013).

–bibliography–

- Sommer, M., 'The Romantic Cave? The Scientific and Poetic Quests for Subterranean Spaces in Britain', *Earth Science History* xxii (2003) pp.172-208.
- Sorensen, R., 'Parsimony for Empty Space', in *Australasian Journal of Philosophy* xcii (2014) pp.215-30.
- Spiller, E., 'Model Worlds: Philip Sidney, William Gilbert, and the Experiment of Worldmaking', in *Science, Reading, and Renaissance Literature: The Art of Making Knowledge* (Cambridge: Cambridge University Press, 2004).
- Sprankling, J.G., 'Owning the Centre of the Earth', *UCLA Law Review* lv (2008), pp.979-1040.
- Sprenger, S., 'Mind as Ruin: Balzac's "Sarrasine" and the Archaeology of Self', in *Histoires de la Terre*. ed. L. Lyle & D. McCallam (Amsterdam: Rodopi, 2008).
- Stafford, F.J., *The Last of the Race: the Growth of a Myth from Milton to Darwin* (Oxford: Oxford University Press, 1994).
- Stapleford, B., 'The Art and Science of Heterocosmic Creativity', in *Collision of Realities: Establishing Research on the Fantastic in Europe*. ed. L. Schmeink & A. Böger (Berlin: Walter de Gruyter, 2014).
- Stapleford, B., 'The Discovery of Secondary Worlds: Notes on the Aesthetics and Methodology of Heterocosmic Creativity', in *Heterocosms: and Other Essays on Fantastic Literature* (San Bernardino: Borgo Press, 2007).
- Steinberg, M., *Enlightenment Interrupted: The Lost Moment of German Idealism and the Reactionary Present* (Winchester: Zero Books, 2014).
- Stewart Thomson, K., *Before Darwin: Reconciling God and Nature* (New Haven: Yale University Press, 2005).
- Stewart Thomson, K., *The Legacy of the Mastodon: The Golden Age of Fossils in America* (New Haven: Yale University Press, 2008).
- Stewart, P., 'Science and Superstition: Comets and the French Public in the 18th Century', in *American J. of Phys.* liv (1986) pp.16-24.
- Stigler, S.M., 'Who discovered Bayes's Theorem?', in *American Statistician* xxxvii (1983) pp.290-96.
- Stolleis, M., & L. Daston, *Natural Law and Laws of Nature in Early Modern Europe: Jurisprudence, Theology, Moral and Natural Philosophy* (London: Routledge, 2008).
- Strangeland, C.E., *Pre-Malthusian Doctrines of Population: A Study in the History of Economic Theory* (New York: A.M. Kelley, 1966).

—secondary sources—

- Suddendorf, T., & M.C. Corballis, 'The Evolution of Foresight: What is Mental Time Travel, and is it Unique to Humans?', in *Behav. Brain. Sci.* xxx (2007) pp.299-313.
- Sunstein, E.W., *Mary Shelley: Romance & Reality* (Baltimore: Johns Hopkins University Press, 1991).
- Swanson, L.R., 'The Predictive Processing Paradigm has Roots in Kant', in *Frontiers in Systems Neuroscience* x (2016) doi.org/10.3389/fnsys.2016.00079
- Sylwanowicz, M., *Contingent Causality and the Foundations of Duns Scotus' Metaphysics* (Leiden: Brill Publishing, 1996).
- Synder, L.J., *Reforming Philosophy: A Victorian Debate on Science and Society* (Chicago: University of Chicago Press, 2006).
- Tang, C., *The Geographic Imagination of Modernity: Geography, Literature, and Philosophy in German Romanticism* (Stanford: Stanford University Press, 2008).
- Tang, N.F., *Kant's Modal Metaphysics* (Oxford: Oxford University Press, 2016).
- Tattersall, I., 'What Happened in the Origin of Human Consciousness?', in *Anatomical Record, Part B, The New Anatomist* cclxxvi (2004) pp.19-26.
- Taylor, P.D. 'Extinction and the Fossil Record', in *Extinctions in the History of Life*. ed. P.D. Taylor. pp.1-34 (Cambridge: Cambridge University Press, 2004).
- Tegmark, M., 'The Multiverse Hierarchy', in *Universe or Multiverse?* ed. B. Carr (Cambridge: Cambridge University Press, 2009).
- Thacker, E., *After Life* (Chicago: University of Chicago Press, 2010).
- Thacker, E., 'Darklife: Negation, Nothingness and the Will-to-Life in Schopenhauer', in *Parrhesia* xii (2011) pp.12-27.
- Thacker, E., 'Notes on Extinction and Existence', in *Configurations* xx (2012) pp.137-48.
- Toffler, A., *The Futurists* (New York: Random House, 1972).
- Torres, P., *Morality, Foresight, & Human Flourishing: An Introduction to Existential Risks*, (Durham: Pitchstone Publishing, 2017).
- Tresch, J., *The Romantic Machine: Utopian Science and Technology after Napoleon* (Chicago: University of Chicago Press, 2012).
- Trumpener, 'Afterword: The World Viewed', in *Global Romanticism: Origins, Orientations, and Engagements, 1760-1820*. ed. E. Gottlieb (Lewisburg: Bucknell University Press, 2015).

–bibliography–

- Tucker Jones, R., *Empire of Extinction: Russians and the North Pacific's Strange Beasts of the Sea, 1741-1867* (Oxford: Oxford University Press, 2014).
- Tulving, E., 'Chronesthesia: Conscious Awareness of Subjective Time', in *Principles of Frontal Lobe Function*. ed. D.T. Stuss & R.T. Knight. pp.311-325 (Oxford: Oxford University Press, 2002).
- Turchin, A., 'Message to Any Future AI: "There are several reasons why exterminating humanity is not in your interest"', published online: <https://goo.gl/YArqki> (2017) accessed 04/09/2018.
- Turvey, S.T., & A.S. Cheke, 'Dead as a Dodo: the Fortuitous Rise to Fame of an Extinction Icon', in *Historical Biology* xx (2008) pp.149-63.
- Tuttle, L., *Conceiving the Old Regime: Pronatalism and the Politics of Reproduction in Early Modern France* (Oxford: Oxford University Press, 2010).
- Unger, R.M., & L. Smolin, *The Singular Universe and the Reality of Time: A Proposal for Natural Philosophy* (Cambridge: Cambridge University Press, 2014).
- Vail, J., "'The Bright Sun was Extinguish'd": The Bologna Prophecy and Byron's "Darkness"', in *The Wordsworth Circle* xxviii (1998) pp.183-92.
- Vakoch, D.A. & M.F. Dowd eds., *The Drake Equation: Estimating the Prevalence of Extraterrestrial Life through the Ages* (Cambridge: Cambridge University Press, 2015).
- Vallins, D., K. Oishi & S. Perry, *Coleridge, Romanticism and the Orient: Cultural Negotiations* (London: Bloomsbury, 2013).
- Verschuur, G.L., *Impact!: the Threat of Comets and Asteroids* (Oxford: Oxford University Press, 1996).
- Vicario, M.A., *Shelley's Intellectual System and its Epicurean Background* (London: Routledge, 2007).
- Vijn, J.P., *Carlyle and Jean Paul: Their Spiritual Optics* (Philadelphia: John Benjamin's Publishing Company, 1982).
- Virvidakis, S., 'On Kant's Critique of Thought Experiments in Early Modern Philosophy', in *Thought Experiments in Methodological and Historical Contexts*. eds. K. Ierodiakonou & S. Roux (Leiden: Brill Publishing, 2011).
- Wagar, W.W., *Terminal Visions: the Literature of Last Things* (Bloomington: Indiana University Press, 1982).
- Walicki, A., *A History of Russian Thought from the Enlightenment to Marxism*. trans. H. Andrews-Rusiecka (Stanford: Stanford University Press, 1979).

—secondary sources—

- Walker, P.D. *Germinal and Zola's Philosophical and Religious Thought* (Philadelphia: John Benjamin's Publishing Company, 1984).
- Ward, P., *The Medea Hypothesis: Is Life on Earth Ultimately Self-Destructive?* (Princeton: Princeton University Press, 2009).
- Warshofsky, F., *Doomsday: The Science of Catastrophe* (New York: Reader's Digest Press, 1977).
- Way, B., *Rise of the Necrofauna: The Science, Ethics, and Risks of De-Extinction* (Vancouver: Greystone, 2017).
- Weber, M., *The Protestant Ethic and the Spirit of Capitalism* (London: Penguin, 2002).
- Wegter-McNelly, K., 'Contingency & Necessity', in *Religion Past & Present*. ed. H.D. Betz (Leiden: Brill Publishing, 2007).
- Wells, H.G., *Mind at the End of its Tether* (London: Windmill Press, 1945).
- Wells, H.G., *The Great Science Fiction* (New York: Vintage Books, 2017).
- Wettersten, J. & J. Agassi, 'Whewell's Problematic Heritage', in *William Whewell: A Composite Portrait*. ed. M. Fisch & S. Schaffer. pp.345-69 (Oxford: Oxford University Press, 1991).
- Willis, M., *Mesmerists, Monsters, and Machines: Science Fiction and the Cultures of Science in the Nineteenth Century* (Ohio: The Kent State University Press, 2006).
- Wilson, E.G., *The Spiritual History of Ice: Romanticism, Science and the Imagination* (New York: Palgrave Macmillan, 2003).
- Winsberg, E., *Science in the Age of Computer Simulation* (Chicago: University of Chicago Press, 2010).
- Wood, G.D., *Tambora: The Eruption that Changes the World* (Princeton: Princeton University Press, 2014).
- Young, G.M., *The Russian Cosmists: The Esoteric Futurism of Nikolai Fedorov and his Followers* (Oxford: Oxford University Press, 2012).
- Zapffe, P.W., 'The Last Messiah, Trine Riel translates Peter Wessel Zapffe', in *After Us* ii (2016) pp.22-5.
- Zeimbekis, J., 'Thought Experiments and Mental Simulations' in *Thought Experiments in Methodological and Historical Contexts*. eds. K. Ierodiakonou & S. Roux (Leiden: Brill Publishing, 2011).
- Zerefos, C.S., 'Atmospheric Effects of Volcanic Eruptions as Seen by Famous Artists and Depicted in their Paintings', in *Atmos. Chem. Phys* vii (2007), pp.4027-42.

—bibliography—

Ziolkowski, T., 'The Mine: Image of the Soul', in *German Romanticism and its Institutions*. pp.18-63 (Princeton: Princeton University Press, 1990).

Zittel, K.A., *History of Geology and Palaeontology to the End of the Nineteenth Century* (London: Scott, 1901).