parrhesia 27 · 2017 · 88-115

life after extinction

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Extinction is a fact of biological periodicity and deep time, yet knowledge of the finitude of species is also a marker of modernity and the present. The extinction of species is one way we have come to understand both vast stretches of time past and the precariousness of life today. It was only in the early nineteenth century that species extinction began to be accepted as scientific fact, with evidence of animal remains unearthed whose anatomy did not identically correspond to any living beings. Yet it is no coincidence that early theories of extinction by Cuvier and Darwin arose at the same time as a visible rise in animal extinction rates began to occur. Darwin's account of extinction in *The Origin of Species* drew on testimonies of animal depletion from naturalists spread across the globe and located also right in England, where Darwin was witnessing in his lifetime evidence of island biogeography diminution of species.

An extinction event is paradoxically both eliminative and generative in Darwin's model, in that the loss of one species frees up opportunities, resources, and space for another.

> The theory of natural selection is grounded on the belief that each new variety, and ultimately each new species, is produced and maintained by having some advantage over those with which it comes into competition; and the consequent extinction of less-favoured forms almost inevitably

> follows.... Thus the appearance of new forms and the disappearance of old forms, both natural and artificial, are bound together.[1]

Darwin elaborates:

> for as new forms are continually and slowly being produced, unless we believe that the number of specific forms goes on perpetually and almost indefinitely increasing, numbers inevitably must become extinct. That the number of specific forms has not indefinitely increased, geology shows us plainly; and indeed we can see reason why they should not have thus increased, for the number of places in the polity of nature is not indefinitely great.[2]

The emergence of new life forms is intimately bound with the destruction and vanishing of old forms. New existences arise on the graves of old, the new forms of life that live on are bound together with the specters of other species, and the emergence of new species means that death to the point of extinction is the fate of other, "less-favoured" forms of life.

There is no clock that tells us when extinction will happen for a given species, yet statistically there are measurements of the average rate of extinction and also measurements of extraordinary accelerations in extinction, or mass extinction events. Paleontological research indicates that approximately 99 to 99.9% of all species in the history of our planet have gone extinct.[3] Ernst Mayr estimates that well over one billion species have disappeared in the history of the earth.[4] These numbers show the astonishingly devastating yet consistent and functional role that extinction plays in speciation. Species extinction often follows statistical norms but also is capable of huge fluctuations and casting norms of life aside. In the language of nineteenth century biology, extinction is both uniformitarian and catastrophist. Extinction is regulative and alarmist, functional and apocalyptic, regenerative and disastrous, manageable and entropic, universally permanent yet perhaps locally reversible. How do we comprehend this condition where both the fragility and regularity of conditions is built into what makes them possible in the first place?

I do not take it for granted that we know what are the philosophical, psychological, literary, and biological effects of extinctions, or even to what extent extinction can be cognized at all. Circumstances of contingency and finitude suffuse

processes of natural selection at work in the generation and collapse of life, and it is an open question how these same circumstances factor into any philosophical conceptualization of life. Extinction also raises fundamental ontological questions that extend beyond any philosophy of life. Life is not the same as being in general, and so biological questions raised by extinction have limited relevance to general philosophy. But if life is only one domain of ontology and not any special or privileged medium for asking ontological questions, how then should one construct a philosophical thought on life within its own limits and parameters, and especially within its own finitudes?

In Eugene Thacker's *After Life*, a study of the genealogy of the generic characterisations of life in philosophy, he shows that ontological categorizations of life that have become standard in Western philosophy resort to defining life with terms that are not strictly biological and are more properly metaphysical. Concepts such as temporality, finality, and immanence are used to define life but do not signify life by themselves. Thacker situates the long history of proposed ontologies of life as residing in a zone between biology and metaphysics first established in the work Aristotle. Aristotle's attempt to offer both an empirical and general (transcendental) definition of life inaugurates a long-standing, intractable ontological dilemma: "On the one hand, any concept of life must be transcendent to life in order to account for its ephemeral nature and its propensity to change. On the other hand, any concept of life must be immanent to life in order to demonstrate the inseparability between principle and manifestation."[5] One of the intrinsic problems here is that any overarching concept of life already may be too generic or abstract, indeed, too conceptual, to be directly pertinent to the complex and provisional concatenations of matter that support life. The philosophical battles at the level of generic ontology end up being over competing abstract conceptualizations of life that move further and further away from the contingent histories of actual plants and animals. Abstraction on its own is not the problem, yet this emphasis on a generic theory of life slants biological problems towards the realm of the cognitive and the categorical. But the constitution and limits of thought are not necessarily the same as the limits of life and life processes. The task then is to elaborate a theory of the living from within biological events that make and unmake life, rather than assume an abstract ontology independent of biological events.

Here I will claim that Darwin develops a philosophy of biology that provides a rigorous yet open-ended baseline of how speciation works that shows extinction

to be both an immanent and statistically common outcome of biological systems as well as a unique event involved in the making and unmaking of species. In Darwin's model, both difference and collapse, or speciation and extinction, define the condition of species, yet a significant number of recent philosophers of life coming from diverse methodological backgrounds have put an almost exclusive focus on the *becoming* of speciation. Darwin's emphasis on including extinction within the ambit of regular biological processes has been repeatedly underrated in a wide variety of philosophies of life from the past century, including Henri Bergson's *vitalism*, Gilles Deleuze's *neo-vitalist* philosophy of virtual life, and Richard Dawkins' *genetic reductionism*. I discuss how vitalist and reductionist philosophies of life both appeal to meta-biological principles of the infinite repeatability of life (Deleuze) or the theoretically immortal germ plasm/DNA (Dawkins). Both kinds of philosophies underplay how the extinction of species conditions the conditions of life. I then turn to some arguments for and against the overlapping of the biological and the philosophical in thinking extinction proposed by Quentin Meillassoux and Ray Brassier. Both Meillassoux and Brassier argue that precariousness applies to all things in the universe, and Brassier goes as far as to make extinction the index of a kind of transcendental entropic principle. Both philosophers take the undoing of life well beyond the biological into assertions about a general ontological condition, which effectively makes the specific precariousness of biological life not very important in their thinking of extinction. By making extinction so radically pervasive (although Meillassoux will ultimately argue that this is not the final principle of the universe), biological extinction and the vicissitudes of species forms lose their specificity and coherence. Ultimately the critique I make of Meillassoux and Brassier is not of their conclusions, but in the way their methodologies skip over addressing a number of steps and distinct phases that makes extinction a coherent biological problem to begin with. The steps by which species are made and unmade need further scrutiny to understand what extinction means for the biological condition, and this methodological focus need not be instantly recombined with metaphysics. Finally, the essay finishes with a return to emphasizing the relevance of Darwin's description of the sustenance and collapse of life together in the same unfolding processes of evolution.

The bulk of this essay provides a critical assessment of philosophies of life that minimize and discard extinction or philosophies of extreme contingency that render extinction too abstract or absolute, but then what theory of extinction is to be offered instead? Rather than aiming for a generic theory of life or death, I am interested in how to account for the lives of species in the context of the way

the biological condition incorporates an inevitable unraveling of its own biological systems. Instead of beginning with meta-biology or an abstracted formal definition of life, the thought of extinction must first contend with how extinction happens within biological life, even as it empties biology from within. Even if the initial cause of an extinction event is something biologically external—a comet or a severe change in climate—what ensues is a breakdown at the species level of the survival and reproductive capacities that maintain organisms and allow future speciation. Ways of living involve species in both the elaboration and breakdown of the internal/external differences that maintain life; these processes of living overlap with processes of dying such that both condition the conditions of life. At the same time, as Darwin shows, extinction is part of the process of speciation and can contribute to a broader (but not indefinite) proliferation of life. Extinction then entails questions about what species are, what we mean by the term species, how individuals and species are co-implicated, and what are the limits of life—and extinction raises these questions in the very disintegration of life.

The reason I turn to yet another rethinking of Darwin is to draw out his insistence that life is made and unmade in the same extended process, meaning that extinction is not an isolated, secondary outcome of life but has causal effects throughout the process of speciation. "No one I think can have marvelled more at the extinction of species, than I have done,"[6] Darwin stridently announced in *The Origin of Species*. What seems so strange then is how many of the prominent theorists of Darwin in the traditions of critical theory and reductionist science have ignored this declaration. This is not to say Darwin got everything right about extinction—for example, he thought it very unlikely that extinction could happen at a fast rate and did not support the theory that mass extinctions could have happened.[7] I turn to Darwin to emphasize how his thinking of extinction as immanent to the conditions of the biological proves crucial in providing a factual account of species finitude and a theoretical model for thinking how species can be defined as changing and self-differentiating but also as prone to complete disappearance. Darwin's work establishes a view of life both enabled and effaced by extinction, which allows for a conceptualization of species uniqueness and the development of biological thought based on how the immanent conditions of life also immanently un-work themselves. Species extinction has both empirical and ontological consequences, and both must be accounted for methodologically in any theory of life. "When a species has once disappeared from the face of the earth, we have reason to believe that the same identical form never reappears,"[8] Darwin writes. The loss of any single species is a unique moment such that there will never be

that form of life again, and this subtraction has rippling effects on the conditions of any further conditions of life. The Darwin I examine then is a thinker of both becoming and the failure to become, species transformation and species eradication, difference and devastation, uniqueness and erasure.

Throughout this essay, I make a case for focusing on the species form as a crucial biological object that allows for extinction to be coherent in the first place, even as any specific species form is continually changing and symbiotically entwined with other species. I argue against tendencies to *overmine* and *undermine* the species form (to borrow Graham Harman's terms[9]) as something secondary and of minor importance because it is supposedly superseded by larger ontological processes such as vitalism or is seen as a temporary manifestation of activity that essentially occurs at the micro-cellular level of the gene and gene pool. Deleuzian theorists of the philosophy of biology argue for a *productionist* view of speciation that views organisms as constantly changing and creating, even, paradoxically, when they die. This view relies on implicit assumptions that life can be generative indefinitely without much regard to species forms, ecological limits, or to the failures and finitudes of extinction. While Deleuze overmines the species form with his generic vitalism, many reductionist and eliminitivist neo-Darwinian philosophies undermine the species form and put overly restrictive limits on how to understand biological extinction by focusing on genomic activity exclusively or by shifting from problems of biology to problems of cognitive theory. Extinction, in this reductionist context, is seen as just an inevitable material circumstance that seemingly does not tell us much about biological processes other than showing how a germ line ends or the closing of the window of consciousness. In contrast to these positions, the Darwin that I sketch here is not just a thinker of effusive generative difference nor committed to explaining all biological systems as following a generic, perpetual mechanism of natural selection, since the conditions of natural selection are themselves conditioned by the fate of species. Rather there is another Darwin who combines collapse and continuity, the melancholic and the normal, in the self-same processes that make life livable and unlivable.

We need a more robust conceptualization of extinction not just because it will tell us more about the end of thought and the finitude of being, but also because it will tell us more about how biological systems work and un-work themselves immanently. There does not need to be a direct metaphysical payoff for this line of inquiry. The task then here is to think conceptually about evolution and to build a theoretical understanding of extinction but without necessarily favoring high

conceptual problems or metaphysical controversies. Clearly, one of the reasons that a careful attention to extinction matters is because to think ecologically and to be knowledgeable about the lives of animals (including ourselves), we need to understand how they flourish and how they fail, how biodiversity thrives and how it collapses. If we are to live ecologically as best we can, we need to develop complex theorizations of how ecologies are made and unmade. If we only understand the generative and creative aspects of embodiment and ecosystems, we will not have a complete picture of how fragility as much as vibrancy is at stake in matter and life. Here I make use of the term *precarity* to signal the unstable means of biological systems as well as the way individual lives and species flourish or fail in and through these unstable means.[10] The species form is its own precarious object that concerns not just generativity and difference; fragility and failure is at stake in both structuring and unstructuring processes throughout the entire course of speciation.

THE SPECIES FORM AS MOVING BASELINE

Any theory of how life is imbricated with extinction must address "the species problem"[11]: namely, it is not clear that we even know how to define species today. Are species a natural kind or a classificatory convention? Should species be defined by DNA, descent, shared capacity to sexually reproduce, structural homology, regional and temporal isolation, or some other criteria? How do we differentiate between species and speciation, or variety and the process of variation? In several instances in *The Origin of Species*, Darwin indicates he recognizes the ambiguity of the term from the outset, but also welcomes the conceptual vagueness that comes with the notion of species. "Nor shall I discuss the various definitions which have been given of the term 'species.' No one definition has satisfied all naturalists; yet every naturalist knows vaguely what he means when he speaks of a species."[12] Darwin repeatedly states that he finds no consistent way to distinguish species from varieties, and ultimately suggests that the distinction is more a problem for taxonomists than relevant to the lives of organisms: "It is immaterial for us whether a multitude of doubtful forms be called species or sub-species or varieties."[13] The ambiguity of the concept of species does not get in the way of Darwin's investigations; rather, he is able to better theorize speciation because he does not insist on a strict definition of species even while he retains the species form as important to biological processes. He keeps the species form even as he deconstructs it. Darwin is helped by the looseness of the term to distance his ideas from essentialism or previously fixed taxonomies, yet he does not cast aside

the species form completely. At the same time, Darwin also recognizes that no one really knows what a species is or can do.[14]

The question of the need to consider the species form as a coherent unit, or even as something central to natural selection at all, has been raised more recently by Richard Dawkins in the context of his argument that genes should be first and foremost the focus of natural selection since they are the only direct replicators of life. Dawkins argues that the species form is just a provisional development of the underlying genome and does not play a primary role in evolution, since animals only directly pass on their genomes rather than their species form or phenotype. According to Dawkins, "One feature of life in this world which, like sex, we have taken for granted and maybe should not, is that living matter comes in discrete packages called organisms."[15] Dawkins does not mean that the organism or the species form is irrelevant to biological processes, rather he states that organisms are not exactly discrete packages and do not reproduce themselves as a single, full-bodied entity. He then makes the case for seeing the organism as one form of an "extended phenotype" intermingling among others. Dawkins argues then that organisms are, in effect, just one possible package or extended phenotype shape for genes to express themselves. He calls species "temporary aggregations,"[16] comparing them to clouds always changing shape.

Dawkins' view of the gene is consistently productionist, in that one of the gene's defining characteristics is its apparently endless generation and regeneration. In *The Selfish Gene*, Dawkins mentions that he could have titled the work *The Immortal Gene* on the suggestion of a friend,[17] and calls DNA "immortal coils." Extinction for Dawkins simply represents the elimination of particular genes from a gene pool that is seemingly set on autopilot to reproduce indefinitely. Dismissive of any romance of the species form, Dawkins' position views the end of a species as an end to certain genotypic and phenotypic effects. Yet Dawkins' work also provides the insight into how "extended phenotypes" matter at the genomic level as well as the ecological level, and thus the eradication of phenotypes has consequences for the genotypes and phenotypes of other species. In other words, the loss of the species form has consequential effects at more than one level, from the gene to the ecosystem. To understand the broad stakes of extinction, one must account for these losses at multiple levels, rather than assuming one form of loss (the gene pool) is ultimately all that matters.

In contrast to Dawkins' insistence that organisms or species forms have only a secondary or indirect role in natural selection, Stephen Jay Gould argues that natural selection pressures work on several different levels of life simultaneously, from the gene to the cell to the individual to the population. Regarding the species form, Gould argues that species are tightly bound and functionally integrated,[18] and not as fluid or cloud-like as Dawkins makes them out to be. According to Gould, "Species act as well-defined Darwinian individuals, not as arbitrary subdivisions of a continuum."[19] Gould is well known to be critical of views that are associated with gradualism that claim a slow and steady process of speciation, but his related dismissal of a "continuum" theory of life will prove resonant with the philosophy of continual becoming in Deleuze as we shall see shortly. Against this position, Gould states the case for a view of "punctuated equilibrium" that entails highly variable rates of speciation and extinction, often occurring in brief bursts followed by long periods of little change. Overall, Gould calls his approach a "hierarchical theory of multi-level selection" that is not reducible to one evolutionary location or situation, hence the need to take the species form into account as much as the genome in offering a layered causal modeling of biological events. Gould's anti-reductionist conclusion is that "by defining species as the basic units or atoms of macroevolution—as stable 'things' (Darwinian individuals) rather than as arbitrary segments of a continua—punctuated equilibrium precludes the explanation of all evolutionary patterns by extrapolation from mechanisms operating on local populations, at human timescales, and at organismic and lower levels."[20] Gould's warning against "extrapolation" from one scale or level of causality to all others (which he accuses Dawkins and other reductionists of doing) will return in a different argument later in this essay concerning the capacity to make metaphysical extrapolations from the fact of biological finitude.

Shifting from the term *life* to the term *species* does not solve all conceptual problems regarding extinction, but it does diminish the need to establish a generic definition for organisms and instead builds on how multidimensional aspects of living beings are made and unmade in the overall conditions of speciation. The species form is the manifestation of the intertwined play between genotypes and phenotypes, symbioses and auto-immunities, a *moving baseline* that indicates the integrity of the species form even as genotypes and phenotypes can fluctuate. Genomes are repeatable and consistent yet also are prone to inconsistent timing, error, mutation, external tampering, symbiosis, and dissolution. The genome itself continuously makes and unmakes itself, integrates and disintegrates, as it duplicates itself but also wears itself out. Still, among these fluctuations and multiple

causal pressures, a rigorous yet mobile concept of species and speciation provides a moving baseline that allows for an understanding of how contingencies, unforeseen consequences, couplings, fragility, loss, and irreversible disappearances are built into the condition of speciation. A moving baseline allows one to track how a species changes in more than one dimension, or how environmental changes might overwhelm the possibility for a species to change. This moving baseline is not reducible to a nominalism or a heuristic, rather it accounts for the shifting qualities of embodiment of a species, including its symbioses and co-adaptations, while respecting how a unique entity is liable to go extinct. One cannot think the severity of extinction without also thinking the uniqueness and permanent loss of the species form. Extinction can entail a partial or full loss of some genes from a gene pool, but it also is the total loss of a species form, which will never be repeated and will no longer have effects on shaping environments. Furthermore, this moving baseline of the species form is necessary to provide the concept of biodiversity with its own integrity in order to understand it as something variously embodied rather than merely equated with statistical gene pools.[21]

VITALISM WITHOUT SPECIES

Because the species form has historically been aligned with fixity and essentialism, there is a tendency for recent meta-biological theories of life to do away with the species form altogether in order to give primacy to the profound malleability of life. An important and prominent example of this shift occurs in the work of Gilles Deleuze. Deleuze is well known for incorporating a theory of vitalism at the heart of his philosophy of difference.[22] As Deleuze stated, "Everything I've written is vitalistic, at least I hope it is."[23] For Deleuze, especially in the period of *Difference and Repetition* (1968), immanent, productive, differentiating intensities or "pure forces"[24] traverse both ideas and sense, providing the impetus for both thought and life. But from the outset Deleuze will assert that generic life is not the same as the living nor need it be liveable or embodied at all. Generic life, in its purest condition, is synonymous with the vitalist power of the pure virtual potentials that are developed in and through an ongoing procession of difference. There is a gap between generic life as the pure power of the virtual and life as that which can be lived. In Deleuze's account, only the life that can be lived can die. Virtual life, which he also calls "a life"[25] at the end of his career[26], exists as "pure immanence," which cannot be contained in any single body subject to material growth and decay. For Deleuze, "pure" means unformed, immaterial, virtual, qualitative, unmediated, and productive. Virtual life unfolds as continuously differentiating

movement that is the quality intensive to such movement. Extensivity, the external shape or configuration of such movement, is a secondary effect of pure intensivity. Intensive movement is a continuous quality or *spatium* that cannot be segmented. Deleuze also reiterates this distinction as one between individuation as a continuous process stemming from the virtual power of life and the organism (a "dividual") as a temporary configuration or actualization. Yet this immanent "continuum" of life is precisely what Gould rejected as noted earlier.

The difference between the intensive and extensive is important for Deleuze's understanding of life and death. For Deleuze, the gap between bio-physical life and death is a gap external to "a life" as the pure power of the virtual. A death in the externalized physical realm has no effect on the intensive virtual conditions of "a life" other than to invite a new line of individuation. Individual organisms are temporary concrescences of the individuating process; as Deleuze states, "species and parts are not primary; they are imprisoned in individuals as though in a crystal."[27] Deleuze adds, "The highest generalities of life, therefore, point beyond species and genus, but point beyond them in the direction of the individual and pre-individual singularities rather than towards impersonal abstraction."[28] Another name for these singularities is intensities. Species are the differentiated actualizations of this primary condition of differences and forces of intensity. When the organism dies, these "pre-individual singularities" pursue different lines of development. Since processes of individuation and speciation draw from a source of pure immanence, bodily death does not fundamentally disturb these immanent processes or have any lasting effect on them. Extinction at the level of the species is not really a problem for individuation since the species form itself is already only transitory. A loss at the species level is not a loss at the vitalist, virtual level. This is why Deleuze uses terms from holistic embryology to describe general ontology when he declares, "The entire world is an egg."[29]

Alain Badiou claims that the ontology of Deleuze's universe is a One-All.[30] This One-All is a "chaosmos" in plenitude, complete and eternal, while continually differentiating itself internally. There are no gaps or voids or externals to the One-All. However, on rare occasion Deleuze also speaks of a kind of death or formlessness in the virtual, when differentiation is dissipated in an empty form. This death is a flattening of immanence into an eternal indifference without a pulse, which Deleuze describes as a kind of decentered circle.[31] While this death in the virtual is always a possibility for pure immanence to dissipate into its own indifference, it is questionable as to whether such a death has ever occurred anywhere in the

universe, for it would seem to mean a quiescence so indifferent to itself that it would permit no events, not even chaos. There would be no way of accounting for this death in the virtual because no possible form would be able to register this emptiness of a subtracted form. Whether or not this virtual death has occurred, how could any thought or form reach it?

Deleuze never really pursues such questions of radical finitude in his philosophy. Rather he casts death in the virtual as a kind of eternal return of chaos, which is not the same as entropy.[32] What happens at the level of the virtual is that the death of one intensity or line of individuation in turn frees up intensities to pursue other paths. Thus, when Deleuze states that death in the actual, in a kind of doubling back, affects a death in the virtual, he means that some intensive differences are dissolved, which frees up pre-individual singularities to act elsewhere. This is why Deleuze states that, "Every death is double, and represents the cancellation of large differences in extension as well as the liberation and swarming of little differences in intensity."[33] Since only "large differences in extension" are cancelled, this is a chance for smaller, "swarming," nomadic individuations to become "liberated" and aggregate elsewhere, hence not a death at all. A One-All would permit of no permanent subtraction, no unrecoverable energy or form, no irretrievable void. Furthermore, nowhere does Deleuze indicate that a system-wide, irreversible dissipation could ever occur within or to the One-All. Indeed, Deleuze actually argues that entropy is an illusion or a secondary phenomenon and not at all the fate of the universe. Death in the virtual remains enigmatic, if it occurs at all.

Deleuze is foremost a thinker of creativity and generativity, and his philosophizing on death and speciation is assimilated to this metaphysical engine of continual, productive differentiation. Yet in Darwin's own theorizations of life, the role of extinction is not just to clear the way for more generativity elsewhere. The loss of a species form does indeed provide opportunities for other species to fill a vacated niche, but also marks a subtraction and elimination of other potential biological events. Extinction is a generative constraint but also a constraint on generativity. Deleuze, along with Guattari, argues in *What Is Philosophy?* that empirical science is only one relevant aspect to philosophy, and that "radical empiricism"[34] refers to immanent becoming in the widest sense, where philosophical time supersedes historical time. "Philosophical time is thus a grandiose time of coexistence that does not exclude the before and after but *superimposes* them in a stratigraphic order. It is an infinite becoming of philosophy that crosscuts its history without

being confused with it.... Philosophy is becoming, not history; it is the coexistence of planes, not the succession of systems."[35] Aside from the problem of how philosophy itself came to supersede historical time yet still be implicated in its layering of planes, if we are to think species specificity and the loss of specific lives as important and consequential for the possibility of future lives, then coexistence in "grandiose time" and "infinite becoming" is irreconcilable even with "stratigraphic order." There is stratigraphy because layers of sediment and rock, and the species embedded in them, are unique and have effects on subsequent layers—this is how strata are dated in the first place. There is no biological condition in which all species forms can coexist at one time—only certain biological forms are possible at certain times because the available forms contribute to the conditions of possibility for subsequent forms.[36]

Deleuze's own tentative gestures to think with Darwin have been expanded more recently by Elizabeth Grosz into a fuller attempt at a synthesis of these two philosophers.[37] Grosz's own work has important differences with Deleuze especially regarding her emphasis on the role of sexual and natural selection as contributing to embodied sexual difference. However, Grosz clearly favors Deleuze's continuously generative vision—she writes of "life as the ever more complex elaboration of difference"[38] —and effectively dismisses extinction as nothing deeply concerning for life. Grosz claims that, by taking a wider view of life, that is, a general ontology, what Darwin offers is "a concept of life as dynamic, collective, change."[39] For Grosz, any particular species form is not as important as what it can do, become, or endure. The loss of a species form is not as important as what becomings ensue elsewhere. Hence Grosz claims that Darwin offers a "new ontology, an ontology of the relentless operations of difference."[40] The philosophy of life then should flourish (become, overcome) over any philosophy of finitude. According to Grosz, "If an ecology that values not only the living—the present—but also the future could be possible, it would be very close to the (non)moral ontology of Darwinism, which mourns no particular extinction and which waits, with surprise, to see what takes the place of the extinct."[41] There are several problems with this statement that tries to take a longer and futurist view of ecology. To begin, there is no guarantee that anything like an inhabitable ecology will remain after an extinction event, especially if that event is at a massively catastrophic scale. Although some life did survive the five mass extinctions previously recorded on earth, there is nothing guaranteeing such survival, especially not a metaphysical principle of becoming. But even at a small scale, an extinction may mean that no animal or plant takes up the vacated niche—an island that is stripped of its biological resources

can end up effectively as a desert. The collapse of one species can lead to a collapse, not a becoming, of others. In other cases, the collapse of biodiversity could result in one species dominating all others, such that a monoculture takes root that does not signal an "ever more complex elaboration of difference."

As noted earlier in this essay, the vast majority of life vanishes, fails, and does not survive. Why then is life as such theorized so often in terms of production, proliferation, and generativity? Creativity is certainly an aspect of the living, but so are failure and dissolution, which closes off permanently any further speciation in the case of extinction. Creativity and difference are not systematic guarantees but are themselves at stake in the making as well as unmaking of species. Any philosophy of life that sidelines extinction ends up being pre-programmed for redemption and romanticizes the creative over the uncreative or de-creative. Generic vitalist theories of life often assume that the precariousness of life means that life is constantly changing and self-differentiating, but precariousness is not the same as a metaphysics of becoming. One could say then that metaphysics of becoming are actually too powerful, or too creative—becoming is apparently never exhausted, never precarious itself. Sometimes the causal factors of precariousness in biology are not entirely clear, but one need not revert to unlimited metaphysical reserves to explain how processes of speciation can lead to both proliferating difference and eradication of modes of being and becoming.

EXTINCTION WITHOUT METAPHYSICS

The extinction of life on earth provokes questions about whether or not the extinction or entropy of the universe is in any way or sense an absolute.[42] But the extinction of the universe is not at all at the same scale as biological problems internal to biology, unless we assume, as Deleuze seems to indicate, that the universe is in some way living (an "egg" or "a life"). Theorists of life may want to argue that the cosmological perspective is indeed the ultimate truth of the universe, and that vitalism cannot be dismissed based on just empirical science. But instead of tackling vitalism directly here, I am arguing that the uniqueness of biological life (not the same as vitalism or "a life") is most profoundly theorized by Darwin and by post-Darwinian models of the making and unmaking of species. Darwinian thought and any philosophy of life as continual generation and difference are certainly at odds over the issue of extinction. If you find that extinction matters, that the specific forms of species and the loss of these forms matters, and that this loss is not just empirical but structures the conditions of possibility of biologi-

cal life, then Deleuzian vitalism cannot be a sufficient philosophy to understand such loss. Furthermore, the recognition of biological extinction powerfully puts into question some historically entrenched presuppositions about philosophies of the meaning of being and the centrality of self-consciousness in transcendental schemas.

Two important philosophical contributions to the question of how biological extinction may or may not pertain to issues of fundamental ontology are raised by Quentin Meillassoux and Ray Brassier in their recent writings. To understand the radical challenge to any thinking of extinction that these philosophers present will require a brief presentation of their arguments. Meillassoux's *After Finitude* is a daunting work of philosophy that aims to formulate a non-metaphysical and non-subjective concept of the world that is not dependent on correlating thinking to being. One motive for this argument is to provide a philosophical reasoning for how science is able to make claims about events in the universe that take place prior to the appearance of life, or any subjective condition whatsoever. These ancestral events occur independent of the conditions of thought, and thus index a fundamental non-coincidence or non-correlation of thought and being.

This essay is not the space to unpack the precise means by which Meillassoux's arguments are posited, although I will note that Meillassoux uses both logical and mathematical reasoning such as exemplified by Descartes as well as what he calls "indirect demonstration"[43] of the "speculative thesis" (60) of the absolute necessity of contingency. Proceeding from logic and mathematics, according to Meillassoux, distances philosophy from dogmatic assertions of metaphysical first principles and subjectivist frameworks, but philosophy need not be based on or even be beholden to empirical scientific evidence. To contrast Meillassoux and Brassier on this methodological point, Brassier proceeds primarily by induction, extrapolating from the empirical scientific evidence of the extinction of life and thought to arguments for establishing mind-independent objective reasoning. The difference between inductive, scientific reasoning and indirect, speculative reasoning will be important for thinking about extinction, as I will argue in a moment.

As Meillassoux elaborates his argument for being able to think an absolute factical reality independent of the conditions of thought, he examines two foundational yet non-metaphysical principles consistent with math and ontology: the logic of non-contradiction and Cantorian set-theory that states there is more than one

infinite, yet no infinite set that can totalize all sets into a One-All.[44] The logic of non-contradiction entails that contradictory or opposing terms cannot be realized at the same time in any existing object. For example, there cannot be a circular square or a being that both is and is not at the same time. However, from these principles Meillassoux finds no legitimacy for making dogmatic or non-sceptical assertions about why any being is the way it is. Non-contradiction does not perforce lead to claims about the necessity of any being, for example, that squares exist in the first place, or, indeed, that all living beings must go extinct. Circles could suddenly change into squares and what is can turn into what is not at any moment. The principle of non-contradiction obliges no claims on the necessity of something being or becoming what it is. It certainly does not mean that some other principle must explain the being of beings, such as any number of metaphysical assertions including spirit, substance, vitalism, complexity, or any poetic or mystical attunement to being beyond language.

According to Meillassoux, dogmatic metaphysics always adds a second principle—the principle of sufficient reason that states there is a reason why something is the way it is—that is not deducible from the rationally coherent principles of non-contradiction and the non-totality of sets. The reason that obliges us to assume the ontological impossibility of occupying contradictory states at the same time does not entail that there are reasons for why the way the world is as it is. Meillassoux then claims that if nothing is necessarily the way it is, and if neither logic nor metaphysics can legitimately establish that something must exist the way it does, then everything is the way it is without reason. Rather, everything is contingent. Contingency is paradoxically the only absolute. Being is, but there is no why behind it, no cunning of reason, no permanent formal or metaphysical stabilizers, or no meaning of being.

Meillassoux is careful to distinguish this principle of absolute contingency from worldly occurrences of change, becoming, and destruction. The becoming and vanishing of things in the world Meillassoux calls "precariousness" or "empirical contingency":

> But absolute contingency differs from empirical contingency in the following way: empirical contingency—which we will henceforth refer to using the term "precariousness" —generally designates a perishability that is bound to be realized sooner or later. This book, this fruit, this man, this star, are all bound to perish sooner or later, so long as physical and organic

> laws remain as they have been up until now. Thus "precariousness" designates a possibility of not-being which must eventually be realized. By way of contrast, absolute contingency... designates a *pure possibility*; one which may never be realized. For we cannot claim to know for sure whether or not our world, although it is contingent, will actually come to an end one day. We know... that this is a real possibility, and that it could occur for no reason whatsoever; but we also know that there is nothing that necessitates it. To assert the opposite, viz., that everything must necessarily perish, would be to assert a proposition that is *still* metaphysical.... Contingency is such that anything might happen, even nothing at all, so that what is, remains as it is.[45]

It seems critically important to ask what the connections could be between contingency and precariousness, even while recognizing why Meillassoux insists on distinguishing between the two. Certainly both precariousness and contingency share the lack of metaphysical supports, such that there is no reason for why all things perish just as there is no reason for any being to be the way it is. If being is without reason and any transcendental safety, any specific form of being could fail, breakdown, or collapse at any moment. "Everything could actually collapse: from trees to stars, from stars to laws, from physical laws to logical laws; and this is not by virtue of some superior law whereby everything is destined to perish, but by virtue of the absence of any superior law capable of preserving anything."[46] Yet here Meillassoux indicates that he, like Deleuze, questions whether entropy is indeed a universal or "superior law" that consigns everything toward perishing. Meillassoux remarks that statements declaring that all things must perish are themselves metaphysical because they assert a universal necessity to physical laws.

Contingency means that something either could perish or could indeed stay the way it is indefinitely for no reason. "Contingency expresses the fact that physical laws remain indifferent as to whether an event occurs or not—they allow an entity to emerge, to subsist, to perish."[47] Meillassoux contrasts this absolute contingency that could just as well change or not change with the facticity of extinction and physical laws of causality. We are then invited to think the relation of collapse and extinction with the absolute contingency of all things, but are denied a necessary or even ontological link between the two. We must think and not think this relation. We must be able to think collapse at any moment, yet also never assume such a collapse will occur as a supreme ontological fate. Contingency sets us at a

precipice but delivers no force of its own.

In his essay "Spectral Dilemma," Meillassoux even invites the possibility that, if the laws of nature are themselves contingent, then a "counter-natural event"[48] such as the resurrection of the dead would not be by definition impossible. Extinction, the apparent fate of all species under causal laws of nature, is just as contingent as all other causal laws. Temporal irreversibility may be one of these contingencies. Meillassoux admits his argument is perhaps only "formal"[49] and may never become actual. This essay, along with other comments Meillassoux has made on the possibility of an "eschatology of immortality"[50], are an implicit rejoinder and rejection of Ray Brassier's claims regarding the fatalistic and nihilistic extrapolations of extinction. No commentators seem to have yet emphasized this distancing of Meillassoux to Brassier's attempt to extend and think through the implications of Meillassoux's philosophy via the scientific evidence of extinction. According to Meillassoux, while the laws of this universe persist for now, nothing ensures their permanence. Meillassoux does not delve at any depth into biological theory perhaps because he holds out for the possibility, without guarantees, of another biology to come that would not necessarily involve Darwinism or even the species form. Indeed, Meillassoux comes to the exact opposite conclusions of Brassier—everything is contingent, extinction is not fate, and perhaps even lost souls are recoverable, were the laws of this world undone from their merely contingent moorings. Far from simply confirming the ultimate scientific truth of extinction, Meillassoux only grants extinction to be a contingency of this world, and not at all an absolute truth for living beings. After finitude one can envision a condition after extinction. Although Meillassoux dismisses theories of vitalism for their metaphysical dogmatism, he holds out a possibility of a future change in the contingency of natural laws that would allow for a "speculative," vitalistic, eschatological order. Once again this vitalism need not abide any interest in the limitations and fortitudes of the species form, and so much the less for the problem of extinction.

THINKING EXTINCTION FROM THE INSIDE OUT

While Meillassoux argues there is no perforce reason to make an inductive leap from the empirical collapse of life to claims about either the universal or absolute conditions of finitude, such an inductive leap is exactly what Brassier boldly undertakes in *Nihil Unbound* (2007). Brassier's book is a dense and subtle work of thinking about how the "transcendental trauma"[51] of extinction undoes much of

the claims continental philosophers have been making for the past few centuries regarding the question of the meaningfulness of being. Instead of elevating the subject to a transcendental form, the fact of extinction forces the subject to think its own disenchanted ends. As Brassier remarks, the will to know does not console or corroborate with the will to live.[52]

The truth of extinction reveals the internal limits of mind, world, and sense to an external and ultimately cold, non-conscious universe. With extinction, these phenomena that serve to make meaning in the world dissipate, or are "unbound," with the loss of self-conscious beings. Thus the workings of life or thought can become unworkable externalized objects as can any other supposedly transcendental categories of experience or thought.

> Extinction turns thinking inside out, objectifying it as a perishable thing in the world like any other.... This is an externalization that cannot be appropriated by thought—not because it harbours some sort of transcendence that defies rational comprehension, but, on the contrary, because it indexes the autonomy of the object in its capacity to transform thought itself into a thing.[53]

Brassier's book is exceptionally dense and defies any summation that I could possibly offer here. However, briefly, I can sketch his argument as following along the lines of philosophical naturalism, asserting that science can offer an objective, third-person account of first-person states of mind. As life can be explained by biological and chemical processes, there is no reason to assume that there is any special ontological or metaphysical status to life. Thus the thought of being is not tied to any special status of the living (as in Heidegger's philosophy, which accords a special role to "mortals," and humans in particular, in his cosmology of the fourfold). Furthermore, the thought of being does not grant any special status to meaning, experience, or purpose, since all of these supposedly transcendental forms of consciousness are only made possible by a configuration of neurobiological processes which are themselves meaningless and purposeless and will become mute in extinction. The reality of being then exceeds thought and any intelligible form. Brassier then asks whether we should characterize being that cannot be subsumed by thought as "unobjectifiable transcendence," as Heidegger does, or "in terms of immanent objectivity"[54] as neurophilosophers such as Paul and Patricia Churchland and Thomas Metzinger do.

In *Nihil Unbound*, Brassier works through the philosophical propositions involved in giving an objective account of immanence as factical reality, via Alain Badiou's equation of ontology and mathematics, and Francois Laruelle's non-philosophy in which the immanence of the in-itself pertains to all things and concepts and yields no access to any outside inquiry, including the inquiry of thought. Both of these philosophies are understood as concerned with offering an account of being that is not tied to meaning, experience, or any other correlation with subjective thought. The issue of extinction occupies the final third of the book, where Brassier considers Deleuze's complicated claims for intensive and repetitive difference unfolding by a process of individuation in a plane of immanence. As previously discussed, Deleuze claims that entropy is only a secondary phenomenon and has no effect on the pure immanence of intensive differentials. This intensive immanence of difference is a continuous, unstoppable, productive engine. Brassier reads this rejection of entropy as a form of idealism, as indeed Deleuze posits a non-chronological, immaterial, and inexhaustible condition where thought and being are conjoined in the realm of the virtual. But if the scientific account of the world tells us that the laws of thermodynamics and the physics of our universe predict the decimation of all planetary bodies in the universe, Deleuze's claims can only make sense by an appeal to a transcendental idealism-vitalism that supersedes biophysical laws. Contra such idealism and vitalism, everything we know about how life is built out of units that themselves are not alive indicates that we must, as Brassier puts it, "affirm the irreducible reality of physical death along with the autonomy of absolute space-time as identity of difference and indifference, life and death."[55]

I see four significant problems in Brassier's assertion of the identity of difference and indifference, which subsumes local extinctions within a universal, cosmic extinction that is the ultimate reality of space and time:

> 1) Why should the time of extinction of all life supersede any other concept of time, including the chronological, the transcendental, the immediate, the proleptic anticipation of death in the being and time of *Dasein*, and the empty time of the pure virtual that Brassier examines in Deleuze? Even if extinction is inevitable, does that make all other forms of time collapse into this one "time of death" (161)? Brassier elaborates an impressive critique of Heidegger's universal temporalization of *Dasein* and similar problems in phenomenology that conflate transcendental conditions of temporality with conditions of existentiality, subjectivity, or cognitivity.

Brassier is adamant that any argument for the primordial conditions of existentiality will involve a false split between transcendental time and physical time of biology: "every attempt to stipulate a transcendental disjunction between ontological temporality and bio-physical time surreptitiously occludes the empirical conditions of instantiation through which the former supervenes upon the latter" (161). *Dasein* is not primordial; yet is there a way to still consider *Dasein* and other subjective constructions of time as still locally valid, but not at all transcendent? There may be more than one temporal frame in question for any being, and furthermore the sequential passage of time cannot be collapsed into one end time. The universe must pass through temporal stages, and even if these temporalities are all perhaps extinguishable, we cannot skip these and just jump to a generalized extinction. Furthermore, the subjective qualities of time are actually enabled in part by processes of extinction that are concomitant with the process of speciation, as Darwin shows. In other words, localized processes of extinction have contributed in a positive sense to the plural forms of temporality that proliferate within the complexities of speciation, rather than simply wiping all slates clean in one nihilistic sweep. How can we understand the extinction of biological life on Earth as intertwined with but still distinct from the epochal, "transcendental efficacy" (230) of cosmic extinction that Brassier argues is the "anterior posteriority" (230) that foreordains the annihilation of all life?

This philosophical critique is connected to a practical ethical dilemma in our own time: even if extinction is the reality facing all species, this does not let us off the hook right now to just wipe out the biodiversity on the planet for our own immediate pleasures. There are at least two temporal realities to species extinction, the current rapid loss of species and the inevitable futural loss of all species. How should we think and act upon these together? How might we maintain a thought of biological extinction and transcendental, cosmic extinction as intertwined but still distinct processes?

2) Brassier is probably right to state that being qua being means nothing and has no correlate in the mind. But being is not ultimately fated to the "being-nothing" (238) that is the universal "anterior posterity." Cosmic extinction is not nothingness either—even after all stellar events are exhausted something subatomic remains. The remnant and persistence of

non-productive being in-itself are irreducible facticities in being. To think extinction in its various forms, we still need to think being and nothingness together as co-constitutive yet irreducible to each other, without collapsing everything into a flat ontological nothing.[56] Brassier fights for the need to maintain epistemological and ontological dualisms throughout his work[57], but by focalizing on unbinding the two domains, he avoids further consideration of how the long, slow work of nihilation is involved in both the making and unmaking of the conditions of being. My main concern with Brassier's philosophy here is how he skips over any inquiry into the details of how extinction events work and how the specific stages of reaching a zero point of life have both a biological and philosophical import.

3) Just like Deleuze, Brassier also finds little relevance in the species form for philosophical accounts of extinction. Brassier rightly attacks the false fault lines drawn between organic and inorganic, the neurological and consciousness, life and death, all while never referring to the integrity of a particular species as irreducible even if composed of chemical and biological systems. Plants and animals are not more than their biological processes, but they are these biological processes taking place at the integral level of a species in a specific ecological surround. Furthermore Brassier offers no reading or relevance of Darwin as a thinker of extinction, one who does not privilege cognitive or cosmic problems. By skipping directly to the neural level (distinguished as the bearer of "thought") as the privileged site of existential questions, he puts to the side the factical relevance of species integrity in ecological systems, and favors cognitive crises over ecological ones. Furthermore, the variable rate of extinction is not straightforwardly a "transcendental trauma" to all biological life equally—it is stunningly statistically normal yet also easily manipulated by us. Finally, one could argue the temporary flourishing and inevitable extinction of life need not be cast as primarily traumatic, since the end of life is implicit in its conditions of possibility, such that life is marvelous both in its evanescent flourishing and failing (and here one can resituate Freud's pleasurable life-drive and traumatic death-drive as co-constitutive).

4) Brassier speeds extinction along to the horizon of nothingness but extinction can also involve localized conditions of proliferation. Such is the upshot of Darwin's modeling of how the flourishing of one species consequentially can lead to the extinction of another. Worlds without us

> proliferate in our absence. To encapsulate all this excess into nothingness is to propose that total collapse defines the paradigm for the many local and small-scale collapses and expansions that occur. Brassier's identity of difference and indifference ultimately leads to a straight and narrow *telos* of indifference. It may be that such a *telos* is ultimately warranted in an epochal, entropic sense, but its causal power is diffuse and chaotically indirect. In the long term of the universe, life will go extinct, but also in the long term of the universe so far, for some 3.8 billion years, there has been life on Earth, a massive negentropic swirl within entropy.[58]

Since *Nihil Unbound*, Brassier's work has headed in the direction of further grappling with how the rationalist claims of scientific realism unravel any metaphysical reliance on life and the centrality of cognition as fulcrums for being. As he shows, this scientific realism does not mean that the categories of reason fall into irrelevance or norms of intelligibility are whisked away into scepticism.[59] Yet, as important as it is to admit that the intelligibility of biological extinction entails coming to terms with the non-being that is already implicitly in being, it seems to me just as important to grasp how a system can feed off its own conditions within the very loss or breakdown of these conditions. The limits and loss of biological life can make the biological as these unmake the biological. Reductionist processes at work in the forming and dissolution of biological forms will be effectuated at more than one level of biological organization until these very reductionist processes run their course through to their own organized disorganization.

Thinking extinction entails taking nihilism seriously yet also taking the current contingent conditions of life seriously. There is a double irreconcilable split to the real—one catastrophic, neutral to affirmation and negation, irrelevant to meaning, and one affirmative of the differential present, relevant to the collectivity of cares and blindnesses that are assembled on the planet. Trauma makes no sense if one is entirely neutral to the difference between universal dissolution and actually existing ecological states, with their unique concatenations of non-intentionality into intentional beings. Futural indifference does not supersede a being's stake in its affairs, but is the co-constitutive condition of care for beings that persist, inhabiting the double bind of difference/indifference. Without loss and extinction, as in philosophies of endless becoming, there is no ecology; but too much loss and extinction, there is also no ecology.

As Darwin indicated, extinction and generativity are not always clearly demarcated. Proliferation and dissipation of systems co-condition each other. How can the specific processes of the building up and the loss of form be intelligible in ways that connect to but are not the same as the unboundedness of all form? Can unbinding lead to new binds? Precarious life in its collapse is not then the same as nihilism or non-being, although these ontological crises do overlap. Precarity can entail loss of form that changes the stakes of form, which conditions the possibility of other forms to come, in and through failure and the dissolution of existing forms. I am as interested in how we can understand the unwinding as much as the unwound, the species and the spectral.

Norm, contingency, and catastrophe—this is the work of extinction. We need a way of thinking ontology that enables such differential ontologies within being to be coherent at each stage of their flourishing and undoing. Meillassoux thinks contingency and chaos without insisting on any necessary entropic *telos*, while Brassier claims extinction and the finitude of all things will result in an entropic destitution that reveals the ultimate indifference of being and non-being in its wake. Thinking the collapse of biological processes entails both apocalyptic and non-apocalyptic thought, although the former often overshadows the latter. Darwin's own statements hover between calm and catastrophe, as he writes that each being "has to struggle for life, and to suffer great destruction. When we reflect on this struggle, we may console ourselves with the full belief that the war of nature is not incessant, that no fear is felt, that death is generally prompt, and that the vigorous, the healthy, and the happy survive and multiply."[60] A precarious biology would be between a dark biology and the normative, statistic, and stochastic view of biology—a combination that is largely yet unexplored in theories of life. The thought of extinction entails both norm and collapse, regularity and breakdown. We are between care and blindness, function and destitution, hierarchy and contingency, wave and crash.

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NOTES

1. Charles Darwin, *The Origin of Species*. Oxford: Oxford University Press, 1996, 258.
2. Darwin, *Origin of Species*, 90-91.
3. The estimate is from David M. Raup, *Extinction: Bad Genes or Bad Luck?* New York: Norton, 1991, 4.
4. Ernst Mayer, *The Growth of Biological Thought: Diversity, Evolution, and Inheritance*. Cambridge: Harvard University Press, 1982, 139.
5. Eugene Thacker, *After Life*. Chicago: University of Chicago Press, 2010, 11.
6. Darwin, *Origin of Species*, 234.
7. For further criticisms of Darwin's reluctance to recognize mass extinctions, see David M. Raup, "The Role of Extinction in Evolution," *Proceedings of the National Academy of Sciences of the United States of America* 91:15 (1994), 6758-6763.
8. Darwin, *Origin of Species*, 231.
9. See, for example, Graham Harman's use of these terms in "Realism without Materialism," *SubStance* 40:2 (2011), 52-72.
10. The phrase "precarious life" is used by Judith Butler in her book *Precarious Life: The Powers of Mourning and Violence* (New York: Verso, 2004) to describe the unevenly recognized vulnerabilities of bodies (specifically focusing on humans) in an age when not all forms of bodily violence are deemed equal. I adapt the term to apply it to the structuring fragilities and instabilities of the biological condition more generally, and also to highlight how a body or a species can be precarious yet still be robust.
11. See David N. Stamos, *The Species Problem: Biological Species, Ontology, and the Metaphysics of Biology*. Lanham, MD: Lexington Books, 2004; Robert J. Richards, *The Species Problem: A Philosophical Analysis*. Cambridge: Cambridge University Press, 2010.
12. Darwin, *Origin of Species*, 38.
13. Darwin, *Origin of Species*, 51.
14. For further discussion of the evaluative nuances implicit in definitions of species, see Ronald Sandler, *The Ethics of Species: An Introduction*. Cambridge: Cambridge University Press, 2012.
15. Richard Dawkins, *The Extended Phenotype: The Long Reach of the Gene*. Oxford: Oxford University Press, 1999, 4.
16. Dawkins, *The Extended Phenotype*, 99.
17. Richard Dawkins, *The Selfish Gene*. Oxford: Oxford University Press, 2006, vii.
18. Stephen Jay Gould, *The Structure of Evolutionary Theory* (Cambridge: Harvard University Press 2002), p. 650. Gould is influenced by Ernst Mayr's emphasis on the species form in order to comprehend both genetic variance among individuals and changes within a population. The term *species* is a comparative term, used to map distinctions and relations among organisms at various levels. Mayr then declares that, "The species... is the basic unit of evolutionary biology." Mayr also adds, "The species also to a large extent is the basic unit of ecology." Mayr, *Growth of Evolutionary Thought*, 296.
19. Gould, *Structure of Evolutionary Theory*,776.
20. Gould, *The Structure of Evolutionary Theory*, 781.
21. Consider however that without extinction, biodiversity would proliferate exponentially, checked only by individual deaths. This would make the concept of biodiversity rather useless. Extinction and biodiversity require each other to make sense of the proliferation and fragility of the species form. Ursula Heise discusses the ambiguities of the notion of biodiversity in connec-

tion with extinction in "Lost Dogs, Last Birds, and Listed Species: Cultures of Extinction," *Configurations* 18:1-2 (Winter 2010), 49-72.
22. For elaborations on Deleuze's vitalistic thought, see Keith Ansell Pearson, *Germinal Life: The Difference and Repetition of Deleuze*. London: Routledge, I999; Claire Colebrook, *Deleuze and the Meaning of Life*. New York: Palgrave Macmillan, 2010; John Protevi, "Deleuze and Life." *The Cambridge Companion to Deleuze*. Eds. Daniel W. Smith and Henry Somers-Hall. Cambridge: Cambridge University Press, 2012, 239-264.
23. Gilles Deleuze, *Negotiations: 1972-1990*. Trans. Martin Joughin. New York: Columbia University Press, 1995, 143.
24. Gilles Deleuze, *Difference and Repetition*. Trans. Paul Patton. New York: Columbia University Press, 1994, 10.
25. Gilles Deleuze, *Pure Immanence: Essays on A Life*. Trans. Anne Boyman. New York: Zone Books, 2001, 27.
26. Deleuze does slightly vary certain emphases in his thinking on vitalism from the period of *Difference and Repetition*, which is more concerned with a metaphysics of the virtual. His writings in the 1970s retain a vitalist and virtual metaphysics but shift focus toward accounts of intensive processes of becoming that are lived through in examples of desiring machines, symbiosis, animal multiplicities, and embodied becomings. His writings in the 1980s and 1990s evince a renewed insistence on vitalist metaphysics, and he ultimately defines his position in *What Is Philosophy?* as "passive vitalism," which he describes is a "force that is but does not act." Gilles Deleuze and Félix Guattari, *What Is Philosophy?* Trans. Hugh Tomlinson and Graham Burchell. New York: Columbia University Press, 1994, 213. Colebrook cogently states that Deleuzian vitalism is not an argument for universal organicism or "life" as a mystical and unifying condition. "In some sense it is quite appropriate to define Deleuze as a vitalist and a philosopher of life, but this is only if his vitalism is qualified to the point where it is almost an inversion of all that vitalism has come to represent. Far from affirming some force that animates an otherwise inert matter, or an inner principle that directs matter, Deleuze's various philosophical projects begin with forces that do not bear a direction or end within themselves but nevertheless have differential tendencies." Colebrook, *Deleuze and the Meaning of Life*, 135. Deleuze's philosophy is a powers and forces philosophy. These powers and forces are always ongoing, differential in intensity, generative and regenerative, terms that both Deleuze and Bergson associate with a vitalist metaphysics.
27. Deleuze, *Difference and Repetition*, 247.
28. Deleuze, *Difference and Repetition*, 249.
29. Deleuze, *Difference and Repetition*, 216. Deleuze's egg reappears in *A Thousand Plateaus*, where he calls the body without organs an egg, which he also claims is the convergence of "the biological egg and the psychic or cosmic egg." Gilles Deleuze and Félix Guattari, *A Thousand Plateaus: Capitalism and Schizophrenia*. Trans. Brian Massumi. Minneapolis: University of Minnesota Press, 1987, 164.
30. Alain Badiou, *Deleuze: The Clamor of Being*, tr. Louise Burchill (Minneapolis: University of Minnesota Press, 2000), 13. Deleuze himself calls his philosophy the "One-All" in *Difference and Repetition*, 37.
31. Deleuze, *Difference and Repetition*, 299. Colebrook calls such death "a degree zero of intensities," *Deleuze and the Meaning of Life*, 99. Deleuze does employ the notion of zero intensity but indicates that zero means pure intensity, not yet differentiated into gradients or degrees.
32. The powerful influence of Bergson's vitalism extends to this argument concerning entropy. Bergson claims that entropy explains what happens to objects that are taken out of the infinite flux

or mobility of reality. Matter in its individuated state is prone to physical decay, but the universe, according to Bergson, is open-ended and forever changing in a positive, productive sense. Bergson defines life as continuous mobility, activity, and creativity –"immaterial" processes that run counter to materially extended things. Life, "one single immense wave flowing over matter," runs counter to localized entropy, which only drags down things, including individual species. Henri Bergson, *Creative Evolution*. Trans. Arthur Mitchell. Mineola, NY: Dover, 1998, 250.
33. Deleuze, *Difference and Repetition*, 259.
34. Gilles Deleuze and Félix Guattari, *What Is Philosophy?* Trans. Hugh Tomlinson and Graham Burchell, New York: Columbia University Press, 1994, 47.
35. Deleuze and Guattari, *What Is Philosophy?*, 59.
36. The historical, diachronic development of species forms and the synchronic templates they provide for future species forms involve issues of path dependency and generative entrenchment (evolution based on previously entrenched or deeply established evolutionary robustness). On generative entrenchment, see William C. Wimsatt, *Re-Engineering Philosophy for Limited Beings: Piecewise Approximations to Reality*. Cambridge: Harvard University Press, 2007. See also Eric Desjardins, "Reflections on Path Dependence and Irreversibility: Lessons from Evolutionary Biology." *Philosophy of Science*. 78:5 (December 2011), 724–738.
37. Deleuze delves most deeply into Darwin's thought in *Difference and Repetition*, where he aligns Darwin with his own Spinozist-inflected philosophy: "Darwin's great novelty, perhaps, was that of inaugurating the thought of individual difference. The leitmotiv of *The Origin of Species* is: we do not know what individual difference is capable of! We do not know how far it can go, assuming that we add to it natural selection" (248).
38. Elizabeth Grosz, *Becoming Undone: Darwinian Reflections on Life, Politics, and Art Becoming Undone: Darwinian Reflections on Life, Politics, and Art*. Durham: Duke University Press, 2011, 3.
39. Elizabeth Grosz, *Time Travels: Feminism, Nature, Power*. Durham: Duke University Press, 2005, 36.
40. Grosz, *Becoming Undone*, 4.
41. Grosz, *Time Travels*, 221 footnote 4.
42. For an account of what stages the universe may pass into and what the final stages of the universe might be, based on knowledge of recent astrophysical science, see Fred Adams and Greg Laughlin, *The Five Ages of the Universe: Inside the Physics of Eternity*. New York: Touchstone, 1999.
43. Quentin Meillassoux, *After Finitude: An Essay on the Necessity of Contingency*. Trans. Ray Brassier. New York: Continuum, 2008, 62. Meillassoux argues that his method is not strictly deductive (61), but proceeds by pointing out the inevitable inconsistencies of arguments for correlation or metaphysical necessity of first principles concerning being. Meillassoux has called his position a nonmetaphysical "speculative materialism" and a version of realism. Material reality is understood "speculatively" because although it can be grasped rationally, its necessity is not provable. It is very difficult to summarize Meillassoux's argumentative method, as he himself states that philosophy must invent "strange forms of argumentation" (76). Although Meillassoux makes ample use of logic and deduction, he states that his thinking, or philosophy itself, is not necessarily beholden to positive science, deductive logic, or innate faculties of reason (77).
44. These principles are not posited as givens for Meillassoux; they are derived from within the parameters of math and philosophy by testing their own principles for coherence. However, for an argument that some contradictions are conceptually reasonable as well as ontologically factual, see Graham Priest, *Beyond the Limits of Thought*. Oxford: Oxford University Press, 2002.
45. Meillassoux, *After Finitude*, 62-63.

46. Meillassoux, *After Finitude*, 53.
47. Meillassoux, *After Finitude*, 39.
48. Quentin Meillassoux, "Spectral Dilemma." *Collapse* IV (2008), 274.
49. Meillassoux, "Spectral Dilemma," 267.
50. Quentin Meillassoux, "The Immanence of the World Beyond," in *The Grandeur of Reason: Religion, Tradition, and Universalism*. Ed. Conor Cunningham and Peter Candler. London: SCM Press, 2010, 444.
51. Ray Brassier, *Nihil Unbound: Enlightenment and Extinction*. New York: Palgrave Macmillan, 2007, 234.
52. Brassier, *Nihil Unbound*, 227.
53. Brassier, *Nihil Unbound*, 229.
54. Brassier, *Nihil Unbound*, 31.
55. Brassier, *Nihil Unbound*, 203.
56. Brassier's thought has recently developed this question further, yet I still would question whether non-being, as co-constitutive with but not reducible to being, should be the general category that explains variable forms of worldly nothingness. For example, the nothing that indexes the extinction of life is a variable process that occurs in the forming and unforming of life. Is the being-nothing of a species comprehensibly the same being-nothing of a general ontology? The conjunction of being/non-being may be a more general problem for philosophy that does not override, explain, or supersede biological extinction. See Ray Brassier, "That Which Is Not: Philosophy as Entwinement of Truth and Negativity," *Stasis* 1 (2013): 174-186.
57. It's a minor quibble, but Brassier seems to miss one argument for methodological dualism in his analysis of Freud's death-drive. Brassier has Freud as confirming the thesis that, "not only does... death precede the organism, it is the precondition for the organism's ability to reproduce and die. If the death-drive qua compulsion to repeat is the originary, primordial motive force driving organic life, this is because the motor of repetition... is this trace of the aboriginal trauma of organic individuation" (237-38). However, Freud only provisionally entertains the primordial supremacy of the death-drive, but ultimately makes it clear that he rejects this single causal efficacy of the death-drive and insists on the dualism of the drives that includes the libidinal life-drive of Eros. "Our conception has been a *dualistic* one right from the outset, and remains so today more emphatically than ever," Sigmund Freud, *Beyond the Pleasure Principle and Other Writings*, tr. John Reddick (London: Penguin, 2003), 92. Freud actually ponders some empirical evidence that death evolves only later with multicellular organisms, and that unicellular organisms are in essence immortal and endlessly replicating. Though he is not convinced wholly by this evidence of secondary, evolved death, he ends by maintaining the primordiality of both life and death drives.
58. Brassier's argument does push back somewhat against favoring entropy over negentropy. Among Brassier's conclusions is that philosophy must think both entropy and negentropy on the same realist terms as one would the identity of difference and indifference (222). However, negentropic binding and the work of difference are only temporary and epiphenomenal in Brassier's view; Brassier still concludes that a generic unbinding abides in a condition of transcendental indifference where only "an originary *purposelessness*" (236) reigns.
59. See Ray Brassier, "Concepts, Objects, Gems," in *Theory after "Theory."* Eds. Jane Elliott and Derek Attridge. New York: Routledge, 2011, 278-293.
60. Darwin, *Origin of Species*, 66.