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Naturae Discere Mores

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2 I only know that he who forms a tie is lost. The germ of corruption has entered into his soul.
—Joseph Conrad, *Victory: An Island Tale*, 1915

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PRÉCIS

Darwin's *Origin* launched evolution into theoretical orbit and it continues to influence its course. This *magnum opus* detailed a tenable solution to the most fundamental problem of human existence, and although this Promethean vision contains sundry trivial flaws, there is, however, one nontrivial error which misguides several crucial developments – not only in the evolving structure of evolutionary theory, but across the entire spectrum of science, including politico-economics and our general understanding of the human condition and the struggle for life. This problem has led social and evolutionary theorists alike to mistakenly favour earth-based inputs over cosmic inputs, to over-emphasize biological evolution, and to under-emphasize stellar evolution. These methodological and logical errors have, in turn, emphasized the significance of the *individual* "struggle against competitors" over the *cooperative* "struggle against inclement environments", and thus, as a result, fashionable theories relating to *Global Warming, The Problem of Sustainable Economic Development,* and *The Tragedy of the Commons* have been erected on a false foundations – and, moreover, point toward inherently unstable solutions. And to these salient points, in light of the theory presented here, we discover that the effective coordination of global threat mitigation efforts (and thus evolutionary stable strategy) requires unprecedented levels of international cooperation.[1]

Key Terms: *On the Origin of Species*, Charles Darwin, human evolution, mass extinction, tragedy of the commons, sustainable economic development, global warming, ecological economics, ideological environmentalism, stellar evolution, cosmic inputs, global threat mitigation, international cooperation, ultra long-distance dispersal, human survival.

1 This will create a resistance. I suppose the process of acceptance will pass through the usual four stages:

1. This is worthless nonsense,
2. This is an interesting, but perverse, point of view,
3. This is true, but quite unimportant,
4. I always said so (1, p. 464).

§1. INTRODUCTION

On the Origin of Species by Means of Natural Selection, or the Preservation of the Favoured Nations in the Struggle for Life (2)[1] was published in November of 1859, 150 years ago this month, and – with *De Re Militari* (4), *On the Revolutions of Heavenly Spheres* (5), *Mathematical Principles of Natural Philosophy* (6), *An Inquiry into the Nature and Causes of the Wealth of Nations* (7), *An Essay on the Principle of Population* (8), *Two lectures on the checks to population* (9 ; *cf.* S1, pp. 81-82), *Personal Narrative of a Journey to the Equinoctial Regions of the New Continent* (10), *Cosmos: A Sketch of the Physical Description of the Universe* (11), *On the Law which has Regulated The Introduction of New Species* (12), a few volumes of *Annalen der Physik* (13-17),[2] *Non-cooperative games* (19), *The Logic of Scientific Discovery* (20), *A Brief History of Time* (21), and *The Structure of Evolutionary Theory* (22) – stands amongst our most treasured scientific advances.

And as a Fellow of the biological society where Darwin[3] and Wallace[4] announced their discovery on 1 July of 1858 (24), it may come of little surprise that I hold the *Origin* in high regard; I detailed this devotion in a letter last February, in honour of Darwin's (and Lincoln's) 200th birthday (S1). Furthermore, I concur that the *Origin*

> exceeds all other scientific 'classics' of past centuries in immediate and continued relevance to the basic theoretical formulation and debates of current practitioners. Careful exegesis of Darwin's logic and intentions, through textual analysis of the *Origin*, therefore assumes unusual importance for the contemporary practice of science (22, p. 58).

Which is exactly why it is critical to bring the grave nature of the *Origin's* most significant error to light, and to outline the logical implications of this error.

This task would not be nearly so difficult if it were not for the fact that much that we believe today has "been so thoroughly muddled by Plato and Aristotle, whose influence has given rise to such deep-rooted prejudices that the prospect of dispelling them does not seem very bright" (25, p. 9), but I will try, beginning with a rough sketch of three obstacles in our path. Presently, we'll consider the most formidable issue at length, but merely note the others in §3.

Our most terrifying gargoyle is *teleology*.

Several methodological issues make it rather difficult to ascertain how little or much to say about this big problem, so I will offer a brief definition,[5] a contextual footnote,[6] and restrict focus to aspects most relevant to the problem at hand:

> Natural selection does not guarantee the power of adaptation in all circumstances, and if environments change rapidly and profoundly enough, these alterations may exceed the power of adaptation by natural selection, with extinction of most forms as the expected result, even in the most strictly Darwinian of circumstances…
>
> Darwin's hostility to catastrophic mass extinction does not arise primarily from threats posed to the mechanism of natural selection itself, but more from the challenges raised by the prospect of sudden global change to the key… assumption that observable processes at work in modern populations can, given the amplitude of geological time, render the full panoply of macroevolutionary results by prolonged accretion and accumulation.

1 It is somewhat remarkable that a man who died in 1882 should still be influencing discussion among biologists. It is perhaps equally strange that so many biologists failed for so many decades to accept ideas that Darwin expressed in clear and beautiful English (3).

2 In the last of his 1905 papers, …*On the Electrodynamics of Moving Bodies*, Einstein presented… the special theory of relativity. The paper reads more like an essay than a scientific communication. Entirely theoretical, it contains no notes or bibliographic citations. Einstein wrote this 9,000-word treatise in just five weeks, yet historians of science consider it every bit as comprehensive and revolutionary as Isaac Newton's *Principia* (18, p. 1164).

3 Darwin was elected a Fellow of the Linnean Society of London on 7th March 1854.… He remained an active Fellow throughout his life, using the Library as a resource and reviewing papers submitted to the Society. We also received from him copies of his publications which now are a treasured part of the Library (23).

4 Wallace was elected to Fellowship… on 18th January 1871 and remained a Fellow until his death.… The Society… [holds] a number of his manuscripts, as well as much of his biological library, often with interesting marginal annotations (23).

5 Any processes that 'persist toward an end point under varying conditions' or in which 'the end state of the process is determined by its properties at the beginning' (26, p. 49).

6 Perhaps no other ideology has influenced biology more profoundly than teleological thinking… In one form or another it was a prevailing world view before Darwin.… It is reflected by the millenarian beliefs of many Christians, by the enthusiasm for progress promoted by the Enlightenment, by transformationist evolutionism, and by everybody's hope for a better future.…

During the rise of deism, after the scientific revolution and during the era of Enlightenment, there was a widespread belief in the development of ever-greater perfection in the world through the exercise of God's laws. There was a trust in an intrinsic tendency of Nature toward progress or an ultimate goal. Such beliefs were shared even by those who did not believe in the hand of God but who nevertheless believed in a progressive tendency of the world toward ever-greater perfection.… Although Christianity was its major source of support, teleological thinking gained increasing strength also in philosophy, from its beginning with the Greeks… up to the 18th and 19th centuries. The concept of the *Scala Naturae*…, reflected a belief in upward or forward progression in the arrangement of natural objects. Few were the philosophers who did not express a belief in progress and improvement (26, pp. 39- 41).

> The problem of mass extinction became acute for Darwin because geological paroxysm threatened something quite particular, vitally important, and therefore of much greater immediate pith and moment than his general methodological preference for locating all causality in the palpable observation of microevolution… Global catastrophe could undermine the ecological argument that Darwin had so carefully devised… to validate something more particular but no less important: *his culture's central belief in progress…*
>
> To explain the general pattern of life's history, Darwin sought to extrapolate the results of competition ordained by the immediacies of natural selection in ecological moments. In particular…, to argue that most competition, in a world chock full of species, unfolds in the biotic mode of direct battle for limited resources, *mano a mano* so to speak, and not in the abiotic mode of struggle to survive in difficult physical conditions. If struggle by… battle (which favors mental and biomechanical improvement) trumps struggle against inclement environment (which often favors cooperation rather than battle…), then a broad vector of progress should pervade the history of life (22, pp. 1298-1299).

But of course the fossil record has clearly demonstrated that this is not the case; and thus Darwin's need to cater to the teleological worldview of the Victorian era has generated grave and, alas, very long-lasting consequences. This *seemingly* minor flaw in this magnificent and peerless foundational work has spawned unintended consequences: grossly underestimating (or failing to recognize) the mission-critical nature of both (*i*) cosmic inputs (and their unlimited potential for mass extinctions) and (*ii*) the dire need for cooperation (cosmic threat mitigation efforts) at the *global* level. I illustrated these crucial points, including the outline of a unified theory of economic & evolutionary value which sketches its significance insofar as sustainable economic development and global warming concerned (S2), enclosing these findings in a letter (S1) in February,

> but as the exposition of the entire group of considerations would be rather difficult to follow, only a few quite elementary reflexions will be given in the following pages, from which the reader will readily be able to inform himself as to the suppositions of the theory and its line of thought (16, p. 898).

§2. ON DARWIN'S NONTRIVIAL ERROR

The 150th anniversary of the *Origin* and the 200th celebration of Darwin's birth have generated both praise and critical reassessments of Darwin's works and methodology. To date, criticisms have merely recounted trivial errors (*e.g.*, 27).

However, in his most influential work of 1859, in order "to enhance the implausibility of truly catastrophic mass dying, Darwin holds that 'the complete extinction of the species of a group is generally a slower process than their production" (2, p. 318). This nontrivial error has had the net effect of painting ourselves into a teleological corner, leaving us increasingly vulnerable to mass extinction.

Darwin confessed, "Scarcely any plaeontological discovery is more striking than the fact, that the forms of life change almost simultaneously throughout the world" (2, p 322). And in pages 317-318 he had falsely concluded that

> this impression must be an artefact produced by the markedly incomplete preservation of more gradual and continuous change n a woefully imperfect geological record… 'The old notion of all the inhabitants of the earth having been swept away at successive periods by catastrophes is very generally given up, even by those geologists… whose general views would naturally lead them to this conclusion. On the contrary, we have every reason to believe, from the study of the tertiary formations, that species and groups of species gradually disappear, one after the other, first from one spot, then from another, and finally from the world.' (2, p. 302, as cited in 22, p. 1301).

Gould connects the influence these errors continue have across the entire spectrum of science and pop-culture (22).

> In particular, these… assumptions about the extended duration of apparent mass extinctions led geologists and palaeontologists to favour earth-based rather than cosmic physical inputs…, and to focus upon telluric influences (like changing climates and sea levels) that could most easily be rendered as gradualistic in style. So strongly entrenched did this prejudice remain, even spilling over into popular culture as well, that a few years after Alvarez *et al.* published their plausible, and by then increasingly well affirmed, scenario of extraterrestrial impact as a catastrophic trigger for the Cretaceous-Tertiary event, the *New York Times* even ridiculed the idea in their editorial pages, proclaiming… that 'terrestrial events, like volcanic activity or changes in climate or sea level, are the most immediate possible cause of mass extinctions. Astronomers should leave to astrologers the task of

> seeking the cause of earthly events in the stars' (22, p. 1303).

If the problem at hand is not clear by now, please consider an extraordinary new book: *The Cosmic Connection: How Astronomical Events Impact Life on Earth* (28):

> Our ascendancy as a species is usually credited to Darwinian processes, such as passing along traits from one generation to the next, genetic mutations that improve an organism's chances of survival, successful adaptations of organisms to different regions or environments, and the flourishing of one species of another. Nevertheless, evolution is not enough to explain the ascension of the human race on this amazing planet. In its most sweeping terms, life also results from conditions not of our world but of our universe (28, p. 10).

Indeed, the social and the biological sciences tend to place undue importance on very recent events – the social sciences find a great deal of significant data in the past few centuries, and the biological sciences find a great deal of significant data over evolutionary time, but, in reality, the Earth has experienced almost *no* significant cosmic events (and thus we find, in essence, almost no truly useful data) in the course of Hominid evolution.

For example the "asteroid the size of Mount Everest" (28, p. 12) that splashed down along the coast of the Yucatán peninsula, resulting in the complete extinction of 70% of terrestrial life (including 100% of the dinosaurs) and 96% of all marine life, does, to be certain, represent one of the most significant events in natural history and therefore one of the most valuable pieces data on Earth – but neither economics, contemporary theorists, politicians, nations, not popular culture are much concerned with this 'outlier'. And, once again, this is problematic, to say the least because

> knowing how astronomical influences have shaped our world and enabled the human race to evolve and flourish gives us a unique perspective on the nature and direction of life on Earth and the possibility of life on other planets (28, p. 13).

I'll offer another prime example of Darwin's Error as it relates to the underdevelopment and malnourishment of contemporary evolutionary theory: *D. melanogaster* serves as a popular experimental laboratory specimen for several genetic and economic factors, but its popularity is also founded upon the conjecture that, in many aspects, it serves as a representative model for human evolution. But this is popularity is steeped in Darwin's Error, because the only way to construct a proper model would be to add a monte carlo engine that, every once in a great while, annihilated the laboratory in which the experiments were being conducted (thereby brining cosmic inputs into the evolutionary equation). But to paraphrase J.B.S. Haldane, one does not have to be a profound realist to realise that a science which consistently underestimates the probability of mass extinction will find favour with socialists, the devout, and others clinging to teleological fairytales (1).

This is the true nature of the beast.

And to make matters worse yet, those able-minded theorists (such as Alvarez *et. al.*) who possess the courage and take the time to patiently offer these unfashionable perspectives are invariably ignored or ridiculed. Another such individual, Milutin Milankovitch, quietly pointed out that the Earth's axis is not fixed, but rather oscillates over a 41,000 year cycle, an oscillation which appears to have influenced (and *continues* to influence) climate change (28), perhaps to greater degrees than greenhouse gas emissions. And, like many misunderstood scientific visionaries, Milankovitch was certainly on to something when practically everyone else thought he was not" (28, p. 38).

How was it that he was able to see something so clearly which so many others could not?

By simply adopting the worldview necessary to grasp the discovery illuminated here.

> Milankovitch did not merely see the Earth and its sediments; he saw the Earth in space and in motion around the Sun over the course of millions of years. It took uncanny vision to step off the Earth and look back from a distance of 100 million miles and watch cogs turn, then forge a… connection… It was the same kind of vision possessed by people like Agassiz, Adhemar, Croll, and Wegener, some of whom paid a high price to see worlds, possibilities, and connections that others could, or would, not (28, p. 28).

Although it is quite true that "nothing makes sense in biology except in the light of evolution" (29, p. 449), it is, also true that nothing *on Earth* (or elsewhere in the universe) makes sense except in the light of planetary, stellar, and galactic evolution:

> Look anywhere beyond our little nook of Galaxy and you will see a universe that is not only dispassionate, but dangerous and random. Comets plough into planets. Stars explode without regard to what clinging forms of life may be in the vicinity. Black holes suck up space and time at will (28, p. 63).

A Short History of Nearly Everything (30) suggests we will never accomplish the feat of interstellar travel. However, as a naturalist, problem-solver, and optimist (as difficult as that may seem to believe) focused upon the problem of human

survival, your author (and others, *e.g.,* 31) has hope that where there is a will, there may be a way. Furthermore, in essence, this theory has already been refuted: not only are we presently capable of interstellar travel, *we have, essentially, been travelling in such a manner for the past ≈13 billion years*: Our planet – along with the rest of our solar system – is speeding through interstellar space at 12 miles per second "in the direction of the constellation Hercules, southwest of the bright star Vega and just north of the billowy clouds of the summer Milky Way" (28, p. 162).

A*nd so logical implications follow from this inescapable interstellar travel?* Well, for one, we may want to start thinking a bit more about the road ahead, being mindful of obstacles we may wish to try to avoid or prepare to meet.

§3. DISCUSSION

The yearning for teleological comforts and disdain for the realism of Milankovitchian worldviews remains so strong[1] that growing legions of *ideological environmentalists* (*cf.* S2) and an entire 'school' of economics (so-called 'ecological economics') have failed to recognize the *existence*, much less the *significance*, of these 'cosmic inputs'. In fact, S2 swings such a heavy wrecking-ball through so many widely-held and wildly popular theories that it may not, ironically, ever see the light of day[2]—but rest assured that, Fortune willing, a big book freighting a very simple and straight-forward message – *one long argument* – is on the way (*cf.* S1, pp. 65-67).

But for now let's briefly consider how S2 falsifies the central thesis of 'ecological economics' (and checks ideological environmentalism to the boards) – a refutation which, as you may note, receives scant attention in S2 – for it is quite unnecessary to falsify a 'subject' which does not exist in the first place (*cf.* S1, pp. 80-81). Take, for example, the central thesis of 'ecological economics', spoken from the mouth of one of ecological economics' founding father, Herman E. Daly…[3]

> But the facts are plain and *uncontestable*: the biosphere is finite, nongrowing, *closed* (except for the constant input of solar energy), and constrained by the laws of thermodynamics. Any subsystem, such as the economy, must at some point cease growing and adapt itself to a dynamic equilibrium, something like a steady state (33, p. 101).

But are the *facts plain* and *uncontestable?*

(i) Is the biosphere *closed?*

(*ii*) Is solar energy a *constant* input? (*cf.* 28).

(iii) Is solar energy the *sole* 'cosmic input' to consider?

Wrong on all counts, three strikes, you're out! I'm afraid school is officially in session for Professor Daly and his colleagues. Please, Dear Professor, turn the thin pages of S2 – it's clearly *not* a closed system, is it?

Perhaps equally troubling is Daly's notion of *steady state,* because the well confirmed existence of a wide variety of chaotic 'cosmic inputs' demonstrates the false and sandy foundation this *a priori* assumption was founded upon. Alas, the Earth has not, is not, nor ever will be in *equilibrium* or *steady state*.

Yes, naturally, the Earth is a precious resource which we must endeavour to protect – but it is also a *depreciating asset* which we must *eagerly* and *voraciously* consume in order to survive, and, given the game-theoretical framework presented in S2, we must assume a depreciation schedule of ≈50,000 years. In brief, our struggle to protect this asset must be balanced with a recognition that we have quite rightly been consuming (and must continue to consume) this resource (ultra long-distance dispersal, *cf.* S2) in our resource-intensive quests (be they direct or indirect) for threat mitigation technologies (spacecraft, telescopes, asteroid tugboats, gravity tractors, alternate food sources, alternative underground/undersea habitats, *etc.*) to help extend the shelf-life of the Earth, and, moreover, our search for another world.

This new concept – *ultra-long distance dispersal* – happens to represent the second obstacle which threatens to thwart our efforts here. Although Hawking champions this objective (*e.g.,* 31), few others second his motion.

This may in part be due to the fact that, given Darwin's Nontrivial Error, with the notable exception of Sherwin Carlquist's revolutionary insights (*cf.* 34-36), theorists have largely failed to recognized the central role of long-distance dispersal in the evolutionary process.

And this brings us to an elementary reflexion on the third obstacle which threatens to obliterate the *truly* inconvenient truths outlined in S2 from the intellectual light of day: the manifold and intrenched problems associated with *specialization*…

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1 I have… summarized the theoretical importance of readmitting truly catastrophic scenarios of mass extinction back into scientific respectability… by stating an emerging consensus about four crucial and general features of such key events, each strongly negative…: mass extinctions are more frequent, more rapid, more intense, and more different in their effects than [scientists] had suspected, and that … Darwinian biology could permit (22, p. 1312-1313).

2 Just as… we support those in whom we have a heavy investment of food and time until they are able to propagate our genes, so we do with ideas. An academic who became famous for espousing an opinion is not going to voice anything that can possibly devalue his own… work (32, p. 240).

3 From 1988-1994 [Daly] was senior economist in the environment department of the Work Bank.… He is a co-founder and associate editor of the *Journal Ecological Economics* (33).

> The specialization of science is inevitable accompaniment of progress; yet it is full of dangers, and it is cruelly wasteful, since so much that is beautiful and enlightening is cut off from most of the world. Thus it is proper to the role of the scientist that he not merely find new truths and communicate it to his fellows, but that he teach, that he try to bring the most honest and intelligible account of new knowledge to all who will try to learn (37, pp. 138-139 ; *cf.* S2).

And thus we have come to the crux of this difficult climb. Oppenheimer estimated that scientists may make up about "one one-hundredth of a percent" of the human population (37, p. 94), and, to make matters worse, as Dawkins often noted, everybody *thinks* they understand evolutionary theory – yet few do. Furthermore, many able-minded scientists reject evolutionary theory based upon previous commitments (religious commitments). Yet another wrench: evolutionary theory is a Western pursuit; it fails to attract relative interest in the East (*e.g.,* all *Neanderthal* researchers are European or North American).

But evolutionary stable global threat mitigation efforts require inconceivable levels of international cooperation. If this communique is intelligible to <.01% of the world, what are our true prospects for survival? 99.99% of all species that have ever inhabited the Earth are extinct; the average species lifespan is 2 Mya. How do we communicate the logical implications which follow from these elementary findings in our fossil record? To this salient point, I will leave you with the closing remark from a talk given at Princeton University on 1 January 1953:

> Research is action; and the question I want to leave in a very raw and uncomfortable form with you is how to communicate this sense of action to our fellow men who are not destined to devote their lives to the professional pursuit of new knowledge (37, p. 129).

MF, Mustique, 9 November 2009

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Supplementary Information

S1. Funk M (2009) *On the Truly Noncooperative Game of Island Life: Introducing a Unified Theory of Value & Evolutionary Stable 'Island' Economic Development Strategy.* An open letter to the Fellows of the Linnean Society of London: http://files.me.com/mattfunk/n90gzv

S2. Funk M (2009) *On the Truly Noncooperative Game of Life on Earth: In Search of the Unity of Nature & Evolutionary Stable Strategy*: http://files.me.com/mattfunk/i7zivw