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On the Truly Noncooperative Game of Life on Earth: Darwin, Hardin, & Ostrom's Nontrivial Errors

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§ 1. ABSTRACT

THIS PAPER introduces a game-theoretical framework for *The Problem of Sustainable Economic Development*, axioms and a complimentary negotiation model which help clarify the problem itself, and, *reductio ad absurdum*, falsify many widely-held economic, evolutionary, and ecological principles. This brief communiqué lays the foundation for evolutionary stable economic development and survival strategies – strategies which foster international cooperation, global threat mitigation, food & energy security, long-distance dispersibility, and thus, ultimately, the long-term survival of the human species.

§ 2. INTRODUCTION

THE THEORY presented here was developed to address core aspects of *The Problem of Sustainable Economic Development* as they relate to the problem of long-term human survival on Earth (and beyond, for that matter). As noted in “one of the best abstracts” UK economist Rob Elliot has “read for many a month” (1), *Darwin's On the Origin of Species by Means of Natural Selection, or the Preservation of Favoured Races in the Struggle for Life* (2)

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 a few minor errors, there is 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. This problem has led theorists to mistakenly favour earth-based inputs over cosmic inputs, to over-emphasize biological evolution, and to under-emphasize stellar evolution. These perceptive, 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 fashionable theories relating to *Global Warming*, *The Problem of Sustainable Economic Development*, and *The Tragedy of the Commons* have been erected upon false and sandy foundations and suggest evolutionarily unstable solutions (3).

Indeed, these fashionable yet entirely false theoretical developments - - especially those pertaining to *The Tragedy of the Commons* - - have been tabled by popular and influential theorists from Garret Hardin (4) to Elinor Ostrom (3).

The following game-theoretical framework is an effort to correct these errors.

§ 3. THESIS

SUSTAINABLE DEVELOPMENT has long been pursued from bases as diverse as geography and geochemistry, ecology and economics, or physics and political science. Increasingly, however, a core sustainability science research program that transcends the concerns of its foundational disciplines and focuses instead on understanding the complex dynamics that arise from interactions between human and environmental systems... How can those dynamic interactions be better incorporated into emerging models and conceptualizations that integrate the Earth system, social development, and sustainability? How are long-term trends in environment and development reshaping nature-society? What factors determine the limits of resilience and sources of vulnerability for such interactive systems? What systems of incentive structures can most effectively improve social capacity to guide interactions between nature and society toward more sustainable trajectories? How can science and technology be more effectively harnessed to address sustainability? (5, p 1737).

We will begin to answer these questions and several others, and in light of this ambitious undertaking, we must hit the ground running: *How can these dynamic interactions be better incorporated into a model for sustainability?*

One states as axioms several properties that it would seem natural for the solution to have and then one discovers that the axioms actually determine the solution uniquely. [Our] two approaches to the problem, via the negotiation model [and] via the axioms, are complementary; each helps...justify and clarify the other (6, p 129).

§ 4. AXIOMS

Axiom I – Survival Certainty Premise. Our first axiom is often referred to as *The Ground Zero Premise* or simply *The Will to Survive*. Darwin called it *The Struggle for Life* (1), the elementary evolutionary truth which simply stipulates that survival is the object of the game (*cf* 7, p vii-viii). Many evolutionary theorists have puzzled over the fact that this axiom eludes many (*e.g.*, 8-9).

Axiom II – Resource Uncertainty Premise. Global natural resource consumption is estimated at rates ranging from 20% to 300% of earthly replenishing rates; however, in light of *Axiom V* and *Axiom VI*, this figure is ultimately indeterminable, as future demand (as altered by future, stochastic events) is unknowable (see *Axiom VI*).

Axiom III – Ecological Uncertainty Premise. *Axiom II* poses uncertain and unquantifiable threats (negative externalities) to *Axiom I* and *Axiom IV*. However, scientific and technological advances derived through inter-dependent linkages associated with *Axiom II* also ultimately yield uncertain and unquantifiable *positive externalities* toward the mitigation of *Axioms IV-VI*.

Axiom IV – Political Uncertainty Premise (10-14).

Survival...is the basic, continuing, inescapable problem for all living organisms [e.g., *Axiom I*]... It follows that survival is the... ‘problem’ for [nations] as well; it is a prerequisite for any other... objectives.... Our economic and social life..., [and] the actions of... governments... [is] directly or indirectly related to... meeting... survival needs (13, *abstract*).

The most significant logical implication which follows from this axiom is that economic power is derivative (15).

Axiom V – Planetary Uncertainty Premise.

Even *if* we are able to mitigate threats posed by *Axiom II* and *Axiom IV* (i.e. *Warfighting*), in light of *Axiom I* and *Axiom IV*, planetary uncertainty mandates that an inhabitable planet *must* be discovered, and the ultimate feat in long-distance dispersal *must* be achieved within an unknown and unknowable time-frame, $\approx 50,000$ years from present (14).

Although details pertaining to risk factors outlined below represent a considerable discourse in of itself, an useful survey (14) highlights and ranks many *known* risks.

However, *any and all known and unknown* risks are theoretically included: the object is not to provide an exhaustive list of global risks, but rather highlight the hereto unrecognized nature of the dilemma astrophysical and planetary phenomena present to *The Problem of Sustainable Economic Development. The Cosmic Connection: How Astronomical Events Impact Life on Earth* (16) offers an excellent overview. It may also be of interest to note, however, that global warming is ranked 9th (ranked 8th in 14), and only three are anthropogenic. Risks are presented in an order of approximate relevance, but these risk factors ultimately lie well-beyond the reach of probability theory:

- (i) *The Problem of Meteorites* (cf 14; 16-17)
- (ii) *The Problem of Super-Eruptions* (cf 14 ; 18)
- (iii) *The Problem of Supermassive Star Collapse* (cf 16 ; 19)
- (iv) *The Problem of Chaotic Behaviour* (cf 16 ; 19)
- (v) *The Problem of Solar Flux* (cf 14; 16)
- (vi) *The Problem of Ohmic Decay* (cf 16 ; 20)
- (vii) *The Problem of Industrial Agricultural* (cf 21-22)
- (viii) *The Problem of Landrace & Richness Loss* (23)
- (ix) *The Problem of Global Warming* (cf. 14 ; 24)
- (x) *The Problem of Ice Ages* (cf. 14 ; 16)

Axiom VI – Universal Uncertainty Premise.

This may represent the least understood, simple truth on Earth (cf. 25-26). *Do we have ample reason to believe the sun will rise tomorrow?* Many conclude that, *yes*, based upon 5,292.5 billion affirmative inferences (365 days X 14.5 Byr), the sun *will* rise tomorrow. However, *Axiom V* highlights phenomena which *eventually will* falsify this inference. “Man has an intense desire for assured knowledge. That is why Hume’s clear message was crushing” (27, p 22).

§ 5. DISCUSSION

WE DO indeed discover that our axioms do determine a solution, as the true nature of countless widely-held – *though obviously false* – theories immediately come to light. Again, in our endeavour to avoid impossibilities, we will highlight several with a simplified version (temporarily setting *Axiom IV* aside) of *The Truly Noncooperative Game of Life on Earth*:

WHAT ARE THE RULES OF THE GAME?

Axioms I – III, Axioms V – VI

WHAT IS THE NATURE OF THE GAME?

Homo sapiens (P_1) vs. *Universe* (P_2).

WHAT IS THE OBJECT OF THE GAME?

$P_1 = \text{Survival}$.

$P_2 = ?$

The Dilemma. As we strategize, a dilemma becomes apparent before play even begins: In light of the fact that P_2 ’s objective = unknown, P_1 faces the dilemma presented by universal uncertainty (*Axiom VI*): P_1 survival requires defending *relative insularity* (of which, more to follow), but this defense must be split between *two essentially contradictory strategies*: S_1 : defending *Ecological Insularity* (*Axioms I-III*), and S_2 : defending *Planetary Insularity* (*Axioms IV-V*).

In other words, all quests for long-term human survival require splitting resources and efforts between two conflicting and counter-productive objectives, but *Axiom VI* renders it impossible to determine how much to allocate to each over time. The impassable difficulty lies within the observation that we can not nor will ever be sufficiently informed to understand how much or how many relatively ‘ecologically degrading’ economic activities have been and always will be required in our necessarily never-ending race to formulate and develop solutions relating to S_2 .

Indeed, this highlights the disquieting nature of *The Prisoner’s Dilemma* (28).

But all hope is not lost; this dilemma does not negate the existence of *Evolutionary Stable Strategy* (29). As several problem-solvers noted regarding an otherwise gloomy outlook for African food security, “the range of possible

human outcomes is large and depends primarily upon the choices that we make” (30, p 11086); although we are certainly in the hands of Nature, much depends upon our hands as well: To this point, recall that “the laws of nature are approximate...: we first find the ‘wrong’ ones, and then we find the ‘right’ ones” (31, p 2); indeed, our *Axioms* enable us to hone in on the ‘right’ ones through a sweeping process of elimination. Several implications which follow from our theoretical framework falsify a wide-range of theories—including the canons of a number of influential contemporary ideologies.

Let’s explore a few logical implications and highlight several glaring errors.

Brundtland’s Error. *Sustainable Development in Small Island Development States: Issues and Challenges* notes the ‘seminal’ *Brundtland Report* defined sustainability as:

Development that meets the needs of the present without compromising the ability of future generations to meet their own needs (32, p 1).

A review of the vast body of related literature reveals that this definition is almost universally accepted, but we trust that we have begun to demonstrate that this definition is theoretically untenable. Yet countless theorists have fallen and continue to stumble into this trap:

Population growth, rising per capita consumption and the use of environmentally malign technologies are steadily eroding [ecological] services.... A major problem is to determine how to allocate resources in various ways to solve the human predicament. Scientists have much of the information necessary for making those decisions, so the biggest problem is in the purview of social scientists. They must help to determine how best to move society from knowledge to action (33:abstract).

But our *Axioms* demonstrate that ‘scientists’ do not nor ever will have the “necessary information” for making these decisions.

How remarkable that this conclusion was derived without the aid of our indirect proof in that revolutionary year of 1776 (10). Innumerable and inevitable ‘altered circumstances,’ which an equal number of ecologists, economists, biologists, sociologists, and sundry social theorists have failed to recognize, will present themselves in due course and – *quite literally* – pound their conjectures to dust.

On Truly Noncooperative Games. Chapter one of *FM 21-76*, ‘The Will to Survive,’ begins: “Two things that you can do now to help you prepare are train for survival in different environments and learn about the area where you

are going” (34, p 1-1), but in light of *Axiom VI*, we remain forever unable to *learn about the area where we are going* because ‘we’ are ‘going’ into the unknown and unknowable *future*, and thus we must emphasize an important section of a revolutionary thesis (35):

There are situations in economics or international politics in which, effectively, a group of interests are involved in a non-cooperative game without being aware of it; the non-awareness [makes] the situation truly non-cooperative (36, p 23).

Indeed, there have always been inescapable situations and there always will be inescapable situations which make the situation truly non-cooperative. In reality, any and all games are truly noncooperative games. Ironically, however, our relentless quest for human survival happens to hinge upon unprecedented levels of international cooperation.

On the Law of Superabundance.

How much is enough?... What are the minimum conditions for the long-term persistence and adaptation of a species or population in a given place? This is one of the most difficult and challenging intellectual problems in conservation biology. Arguably, it is the quintessential issue in population biology (37, p 1-2).

If our answer to this question is not already implicitly clear, we shall render it explicitly: *this problem is also insoluble*. A half-century prior to two of the most significant explorers in this arena (38), a path-breaking, preliminary exploration began as follows:

I think I may fairly make two postulata.

First, That food is necessary to the existence of man.

Secondly, That the passion between the sexes is necessary and will remain nearly in its present state (39, p 4).

These ‘postulata,’ Darwin’s ‘Malthusian Insight’ of 1838, demonstrated an intuitive grasp of *The Law of Superabundance*, and, in light of our *Axioms*, we discover that *real solutions* are neither ‘population control’ (40-41), nor “[increasing] global food and timber supply to accommodate a world growing to 10 billion or more” (42, p 19679), because we’re unable to pursue either strategy with any justifiable conviction since *The Law of Superabundance* stipulates, “the effort towards population ...[is] always greater than the means to support it” (39, p 12). And of course nature knows best, because populations may be decimated (or be wiped-out entirely) at any point in time; we have outlined scenarios whereby, “even if death doesn’t get you right away, you’re unlikely to have much spare energy for sex” (43, p 124).

On the True Nature of Economic Organization.

Very few of us realize... the intensively unusual, unstable, complicated, unreliable, temporary nature of the economic organization by which [we] live... We assume some of the most peculiar and temporary of our late advantages as natural, permanent, and to be depended on, and we lay our plans accordingly. On this sandy and false foundation we scheme for social improvement and dress our political platforms, pursue our animosities and particular ambitions, and feel ourselves with enough margin in hand to foster, not assuage, civil conflict....

But perhaps it is only in England and America that it is possible to be so unconscious... The earth heaves and no one but is aware of the rumblings. There is not just a matter of... '[economic troubles]'; but of life and death, of starvation and existence, and of the fearful convulsions of a dying civilization (44, p 3-4).

As we have clearly illustrated, innumerable phenomena eventually *will* instantly (perhaps with little or no warning) render many, most, or all human survivors (if, that is, there are any) – from Professors to Presidents to Philosopher kings – nomads, fishermen, gatherers, warriors (mostly unarmed), and “hunters, the lowest and rudest state of society” (10, p 747). To make matters worse, it takes *years* – *even generations* – to become *Jägermeistern*, to acquire skills which are being rapidly lost, and of course one must have guns & ammo in order to shoot anything. Someday – possibly tonight – perhaps not for another million years, but, in all likelihood, sometime in the next 50,000 years, *millions*, perhaps even *billions* of people – *especially* the increasingly inter-dependent inhabitants of the so-called ‘first-world’ – will discover just how much Darwinian fitness they truly do or do not possess.

§ 6. SYNTHESIS

AS WORD of Humboldt's death filtered around the world, there was an outpouring of... reverence befitting a beloved international celebrity.... *The Herald* lauded him as ‘one of the greatest men of his age or of any other age.... He had a gigantic intellect, from which nothing in nature or in science appeared to be hid. He could grasp all subjects, and he appeared to know everything... *Cosmos* is his imperishable monument, which will endure as long as the earth which it describes.’ *The Tribune* averred, ‘His fame belonged not only to Europe, but to the world; and in this country especially, probably no man who was known to us only through the

medium of his scientific writings was held in equal reverence and admiration.... But what will ever distinguish Humboldt from the mass of physical inquirers who had preceded him, is his study of the universe as a harmonious whole, and his search for the laws of order, beauty, and majesty beneath the apparent confusion and contradictions of isolated appearances....’

We may well ask, If Humboldt was so widely celebrated and so beloved during his long life..., why has he been largely forgotten in our own time?....

Above all he was a generalist, intent on examining every natural process and shaping the myriad discordant data into a coherent whole, as in *Cosmos*. However, by the mid-nineteenth century, science was progressing so rapidly that it was increasingly becoming the province of specialists, as shown by the trend to replace university departments of *Natural Philosophy* with the narrower disciplines that we know today (45, p 327-330).

This trend has led to systemic failures ranging from the *Denaturalization of Economics* (46) to the *Transformative Hermeneutics of Quantum Gravity* (47). Indeed, as Hardin noted,

it is easy to call for interdisciplinary syntheses, but will anyone respond? Scientists know how to train the young in narrowly focused work; but how do you teach people to stitch together established specialties that perhaps should not have been separated in the first place?....

My first attempt at interdisciplinary analysis led to an essay, *The Tragedy of the Commons*. Since it first appeared in *Science* 25 years ago, it has been included in anthologies on ecology, environmentalism, health care, economics, population studies, law, political science, philosophy, ethics, geography, psychology, and sociology. It became required reading for a generation of students and teachers seeking to meld multiple disciplines in order to come up with better ways to live in balance with the environment (48, p 682).

To this point, your Author was born in August of 1968, just after *The Tragedy of the Commons* was read before the *American Association for the Advancement of Science*, and thus I am amongst the second generation to heed Hardin's call; and “by bringing together all the phenomena and creations which the earth has to offer” (45, p 27), *perhaps I have indeed begun to meld multiple disciplines in order to come up with the best possible way to live in balance with the environment.*

“This sketch is most imperfect; but in so short a space I cannot make it better” (38, p 50). For more details, including methodological desiderata, personal intents, motivations, and full disclosure, please refer to *On the Truly Noncooperative Game of Life on Earth: In Search of the Unity of Nature & Evolutionary Stable Strategy* (49).

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