Darwin and Theories of Everything

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Natura non facit saltum, or "Nature does not make a leap", wrote Charles Darwin in the conclusion of his Origin of Species[1]. Darwin's work on Natural Selection represents an intellectual and scientific triumph, arrived at by asking the question - why all of this change? – and then using scientific observation to form his theoretical framework. His theory has become a kind of biological law, applying on virtually every scale and level within the discipline, illuminating the perplexing notion of change and variation as observed in every aspect of the field.

At the center of Natural Selection is one variable, one grounding for variation that does not vary and from which Nature does not depart, it does not leap: *time*. Natural Selection is a theory based on the absence of gaps, no mysterious "a miracle occurs here" discontinuities. In the same vein, at the center of any theory of physics is the variable of time, from Minkowski space-time to Einstein's time dilation in the special theory of relativity. Time must belong to any theory of physics that hopes to be both predictive and consistent. The difference, though, for physics is that time can move in either direction, positively or negatively, future or past. Particles, planets, and protons don't really care about time's direction when it comes to physical laws. As for Darwin, without time, without forward moving time, and without the freedom to verify his theory based on historical evidence, i.e. a posteriori geological evidence, his theory would have no roots. Natural selection is an "in the mirror" kind of description of what has

[1] Charles Darwin, *The Origin of Species*, (Bantam Classics, 1999).

happened. Indeed, its value in predicting the outcomes of special variation, a priori, can never be tested except on a microscopic scale. Thus, Darwin's greatest intellectual achievement possesses three critical properties: first, it relies wholly on time's backward arrow for verification and its forward arrow for results; second, it is independent of granularity, transcending the scale to which it is successfully applied, and finally, it is not so much predictive and deterministic, but relies on stochastic processes, i.e. events whose timing is not known a priori, but whose distribution of possible outcomes is wholly known. All three aspects provide a connection between Natural Selection and the Second Law of Thermodynamics, which states that systems move forward in time from order to chaos. This is the so-called law of entropy.

The tenets of natural selection are competition and preservation. They constitute a theory that can look back on what went forward and tell us that things could not have been any other way. They are a kind of *Pangloss* theory. Best of all possible worlds. So, the biologists are mostly happy. They have their theory. Poor physics, however, must suffer as the bridesmaid in the parlor after the rice is thrown, wondering when she will get a theory that lasts, a theory that covers all particle behavior, a theory of everything. The physics bridesmaid, though, is uglier than the bride. Therefore, finding the groom is be more of a challenge. For the goals of a theory of everything for physics include: universality[2], a theory whose scale transcends and whose mathematical description encompasses all of the well known physical force laws (gravity, magnetism, Newtonian & quantum mechanics); and time independence, giving this theory the ability to move in either direction with time.

[2] Ironically, as the granularity of physics increases, the theory quest gets blurrier whereas in biology, Darwin's natural selection transcends all levels of scale.

The thesis of this paper is that the process of creating the theory of everything follows Natural Selection. In order to understand this, we need to consider how the process of forming a theory, not the theory itself, works. This requires that we look at a parallel quest in mathematics that occurred at the turn of the 20th century and was obliterated by one of its own residents in 1931. At the beginning of the 20th centure, the field of mathematics had issued and was trying to respond to its own challenge of completely describing itself, i.e. establishing rules to put the whole of mathematics on an axiomatic basis. David Hilbert's *formalism* issued in 1900 claimed that within the next few years, all mathematical thought would be complete. All theorems, all discoveries, all mathematical insight would be achieved. End of story, end of the play, end of thinking? One major attempt to respond to this challenge was carried out in 1910 by Alfred North Whitehead and Bertrand Russell with *Principia Mathematica*. Then, along came Kurt Godel. In 1931 he published a landmark paper entitled *Über formal unentscheidbare Sätze der Principia Mathematica und verwandter Systeme*.

These results, known as Gödel's Incompleteness Theorems, proved that in any axiomatic mathematical system there are propositions that cannot be proved or disproved within the axioms of the system. In particular the consistency of the axioms cannot be proved. The theorems did not destroy the fundamental idea of formalism, but it did demonstrate that any system would have to be more comprehensive than that envisaged by Hilbert. Gödel's are a landmark in mathematics, showing that mathematics is not a finished object, as had been believed. It also implies, for example, that a computer can never be programmed to answer all mathematical questions. Amazingly, mathematics

was at one time in the throws of its own quest for everything, everything mathematical, that is, and it solved its own problem. The answer is simply – no. Mathematical discovery, insight, and creativity will never end. There would always be uncharted water, new frontiers, land unlocked. Hooray for Kurt.

If one extends this result to Physics, one must conclude that there can never be a final theory in physics to describe all of the fundamental forces. Why? Because any attempt to create a stop sign in the road will create a closed system, theoretically speaking. A closed theory system, and that means that it has a boundary and subsequently uncharted water beyond its horizon. Could this mean that there never can be a theory of everything? That it is futile to try to discover one? Furthermore, I conclude that the only form of a theory of everything that we can have is a process of everything – governed, naturally, by Mr. Darwin. A Natural Selection form of a process of everything. There is certainly evidence of the three tenets at work: First, competition – theories of everything are in constant competition for their ability to incorporate all physical force laws as well as being in competition with Nature itself. As the granularity of our understanding of subatomic structures keeps exploding, new knowledge itself represents a formidable competition in our attempt to create a Theory of Everything. Secondly, the process of discovering a Theory of Everything follows the law of preservation. This manifests itself as the heuristic that experimentally affirms correct theories and defeats (makes extinct) incorrect or incomplete theories.

Stephen Hawking, the pre-eminent theoretical physicist whose book is entitled *The Theory of Everything – The Origin and Fate of the Universe,* demonstrates that there are really only three possibilities – we will never get a theory because it doesn't exist, or

the theory is a process which inevitably requires ongoing correction and modification, a kind of theory mutation process that goes with the territory, or we will eventually get one and be done with it. Perhaps the conclusion is that there is no actual Theory of Everything, but only a Darwinian *Process of Everything*.

Any Theory of Everything represents a leap, a final leap into the abyss of the future. Having a theory of everything is not about our intelligence maxing out, nor is it about having CPU's that vibrate at mega or giga or even terahertz before we can penetrate the theoretical darkness. It is about how things are supposed to happen. In the end, probability and randomness drives the open nature of the quest for a Theory of Everything. For Darwin – the randomness lies at the genetic level, and is based on the probability theoretical work of Gregor Mendel; for Einstein and for all of physics, randomness goes back to the Heisenberg Uncertainty Principle. God does not play dice but he built the craps table for us. We have an open universe. We have a journey, not an empty dead-end destination. The band keeps playing and there is never a last dance.