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Applying Ancient Philosophy for the Furtherance of Modern Science

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Abstract. Philosophy is an ancient discipline with a vast accumulation of scholarship. Today there are many overlooked applications for the theories of many Philosophers, as well as the attendant millennia of research. In this paper I outline several concepts in both ancient Philosophy and modern Science which appear to correlate. I begin with a rather in depth analysis of the *'Achilles and the Tortoise'* paradox and its relation to thermodynamics. Second I discuss the *a priori* theory of Kant and how it could be utilized in the field of cognitive science. Finally I touch upon Heraclitus of Ephesus and the relation of his work to modern Chaos theory, suggesting that the labors of the past have conceptual applicability to the studies of the present.

Keywords: Philosophy, Science, History, Inter-Disciplinary, Research.

1. Introduction

The purpose of this paper is to highlight a seemingly overlooked element of the relationship between scientific research and philosophical theory. It is not my intention to speak of the origins of any school of thought, or to quibble about social dominance or academic hierarchy. This paper is designed for the practical purpose of highlighting an apparently neglected opportunity for the work of one discipline to benefit another. In highlighting this instance, and mentioning several other promising similar cases, I hope to impart my own sense of excitement with regard to cross-disciplinary approaches to modern problems.

The main focus of my doctoral research is the extrapolation of cosmological implications from paradoxes, more specifically, the paradoxes which are evident in the remaining fragments of the work of Zeno of Elea. Zeno is considered an ancient Greek Philosopher, although his home, Elea, was actually a Phocaean colony in modern Italy. We will cease the biography here; suffice to say that Zeno was a philosopher and writer, and was ultimately pounded to death in a mortar while attempting to retake his city from a tyrant.[1] His paradoxes were designed to highlight the impossibility of certain cosmologies by creating scenarios in which the system in question would actually prevent the expected outcome of a common and observable event.

This thought experiment we will focus on involves a race between a tortoise and Achilles, and you may quite justifiably be curious as to why someone would use such exotic and possibly distracting figures to illustrate a cosmological point. The answer is twofold; firstly that in Ancient Greece one of these brave athletes was famed for being very fast, and the other famed for being very slow,[2] and secondly that this fictional race certainly sticks in the memory.

2. The Experiment Proceeds

When the race begins the Tortoise receives a head start, either as a kind of handicapping or because it has somehow cheated. It doesn't really matter how far the Tortoise gets during this head start, but for the sake of illustration we shall say ten meters. When Achilles begins the tortoise is already in motion, and he must reach not only each point that the Tortoise has already covered, but each successive point that it covers moment to moment. Now comes the tricky part. Let us assume that there is a fundamental unit of time, a unit which cannot be further divided, a *'cosmic tick'*[3] if you will. While we are at it we shall assume a corollary exists in space, and these days every schoolchild knows about Atoms.[4]

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So we have a Tortoise which is in motion, which means that it is covering at least one *'Atom'* per *'Tick.'* In fact it must be covering *exactly* one *Atom* per *Tick*. Each *Atom* must be traversed, you cannot get to point C without first going through point B,[5] and nothing can be done in less time than one *Tick* because there is no such thing as less time than one *Tick*. Therefore we see that for the tortoise to be in motion he must move at one *Atom* every *Tick*, and no faster, for to move further in the same time would mean not covering some intervening space (teleportation), and to travel the same distance faster would mean that an action had taken place with no time for it to have taken place **IN**.

The conclusion is obvious, that Achilles is bound by the same limitation, and so can never overtake the Tortoise. The paradox lies in the fact that while our rational mind says that Zeno's experiment makes perfect sense, we know from empirical observation that one thing overtakes another everywhere, every day.

3. Increasing Complexity

Above I have used a fixed-scale explanation of the paradox, placing a lower limit on space and time in an attempt to explain the core concept without unnecessary complexities, but I did leave out one important piece of the puzzle. Before we get into that though let me show you how Aristotle related this paradox in his *Physics*:

> *'The second is the so called Achilles, and it amounts to this, that in a race the quickest runner can never overtake the slowest, since the pursuer must first reach the point whence the pursued started, so that the slower, must always hold a lead.'*[6]

So there is the part I left out; no minimum scale is discussed, and so it is textually accurate to assume that the scale is infinitely recursive, meaning what we are looking at is a pair of racers covering smaller and smaller sections of track in smaller and smaller amounts of time, with the practical effect that Achilles comes ever closer to his opponent without ever reaching him. The distance between them becomes infinitely smaller, without ever actually reaching zero. A good way to imagine this is as a kind of slow motion, 'zoom in' of the moment where Achilles approaches the Tortoise.

What we have here is a process which approaches a point infinitely, without ever reaching it. If you have a background in Physics or Mathematics you might see this concept as a familiar one. The corollary in Physics which I am interested in is known as the *'third law of thermodynamics,'* although it seems that the same concept can be extrapolated from the second law as well. The interesting aspect is well represented by the following:

> *'Unattainability of absolute zero is based on the third law of thermodynamics which states that the entropy of a pure substance of absolute zero temperature is zero.'*[7]

We can see from this that the temperature of a pure substance may approach absolute zero, but never reach it. This may be represented in the same way as Achilles' infinite approach to the tortoise, all we need to do is rename the points in a diagram, and it suddenly changes from Philosophy to Physics.

I find this interesting, but more than that, it is potentially useful. There is a long established, if lately neglected, pool of scholarship on the *Achilles* paradox, and now we see that it may have some relation to thermodynamic theory. Thermodynamic science is at the forefront of solving the world's energy problems,[8] and if any of the prior mathematical or conceptual investigations of the *Achilles* can offer a novel and useful framework for investigation, or be of any use to researchers at all, then that is something of benefit to mankind.

What we are talking about here is taking advantage of well established fields of scholarship, which have links to more recent (and fashionable) fields, to the good of all. This does not begin and end with Zeno and his *Achilles*; I shall briefly outline two similar examples of equivalent concepts, which seem to merit further investigation.

4. Other Examples of Neglected Scholarship

The first is a relatively more modern example from the late 1700's. In his *Critique of Pure Reason* Immanuel Kant lays out a system of extracting cognition itself from the particular object of that cognition:

'*Hence if one wants to know how pure concepts of the understanding are possible, one must inquire what are the* a priori *conditions on which the possibility of experience depends and that ground it even if one abstracts from everything empirical in the appearances.'*[9]

This kind of thinking has obvious application in the field of cognitive science, and less obvious application in the development of artificial intelligence;[10] for in understanding our own *a priori* perceptions, we can better share them (or exclude them, as best fits the intended purpose) with the minds that we strive to craft.

The human brain, and by extension mind, is the most complex object we have as yet encountered within the entire explored universe. Anything which can grant even a sliver of insight into the nature or function of a puzzle so fundamental to our very existence should, rationally, be granted significant attention.

Lastly we will touch upon Heraclitus of Ephesus, whose remaining fragments actually contain more than one example which could be used here. Our focus will be on a familiar saying which Heraclitus coined:

'You can never step into the same river twice.'[11]

A concept which is well interpreted in the following way, by Hugh DeLacy:

'What we must understand is not a simple metaphor, which is to be dismissed when we grasp the relation he [Heraclitus] strives to impart, but surging composition, the coming together, the breaking apart, the ever-moving structure of change.'[12]

This is best described as the study of change as a fixed concept in and of itself, one which can make knowable the unknowable; we have a term for that, we call it Deterministic Chaos theory and we use it for the study of everything from politics to the movement of stellar objects. Just to reinforce the link, here is a good definition of the modern field:

*'*Chaos *is the science of complexity of change – Nature's apparent madness in method.'*[13]

So we see that Heraclitus, a man who met his death while trying to cure his gout by burying himself in manure, has something to offer in the same discipline which we now use to model the magnetic fields of celestial bodies.

Who knows, maybe some insight from a thousand years ago about some aspect of Heraclitus' writings will hold the key to making chaotic systems perfectly predictable, leading to all kinds of breakthroughs in multiple fields.

5. Conclusion

The lesson we can learn from this trend of correlation is that while science may be an attempt to rationalize enquiry, watershed moments cannot be scheduled and we never know when the next breakthrough is going to emerge. Thousands of years of philosophical study sits unused, when much of it can be modelled in such a way as to have potential application in any number of more fashionable fields. I highly encourage academics of every stripe to plunder the riches of the past, for the betterment of the future.

6. Acknowledgements

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7. References

[1] Diogenes Laertius, *'The lives and Opinions of Eminent Philosophers.*

[2] The specifics are obvious, even today.

[3] *'Thief of Time'* by Terry Pratchett.

[4] Of course this discounts subatomic particles, however for our purposes the actual 'smallest' unit we choose is immaterial, it only matters that we are assuming an Atomist cosmology in which there actually is one. If you like, feel free to mentally insert your particle of choice.

[5] Zeno pays special attention to this concept in his 'Arrow' paradox.

[6] Aristotle, Physics VI, 9, 15.

[7] B K Sarkar, *'Thermal Engineering,'* Tata McGraw-Hill, P. 45.

[8] The following paper is just one example: *'A Robust Strategy for Sustainable Energy,'* Klaus S. Lackner and Jeffrey D. Sachs, *Brookings Papers on Economic Activity,* Vol. 2005, No. 2 (2005), pp. 215-269 , Published by: The Brookings Institution.

[9] Immanuel Kant, '*Critique of Pure Reason,'* Trans. Guyer & Wood, Cambridge University Press, 1998, P. 227

[10] A link which is made in Dr. Achim G. Hoffmann's work, *'Paradigms of Artificial Intelligence: A Methodological and Computational Analysis,'* Springer-Verlag Singapore, 1998.

[11] This is the more modern version of the saying, a textual translation reads: '*You could not step twice into the same river; for other waters are ever flowing on to you.'* (Heraclitus, Fr. 41)

[12] *'Heraclitus of Ephesus: structure of change,'* Hugh DeLacy, *Science and Society,* Vol. 33, No. 1 (winter, 1969), pp. 42-53, published by: Guilford Press.

[13] N Kumar, *Deterministic Chaos: Complex Chance out of Simple Necessity,* Universities Press (India) Limited (1996), P. xi.