Paper Title: The Continuum, the Discontinuum and the Middle Way
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Paper Abstract:
In this essay I outline a research program to articulate – or re-articulate – an alternative metaphysical framework for the science-religion dialogue.

The representations of scientific and religious worldviews as either entirely opposed or entirely compatible are misleading. Such representations tend to undermine well-intentioned, constructive dialogue. The real relationship is subtle and yet has been found and lost and found again over the last 3,000 years in Western Culture.

Standard representations of the science-religion dialogue engage just two metaphysical frameworks. My treatment argues that there are three metaphysical frameworks involved. This approach parallels that of American Pragmatist C.S. Peirce, who characterized the First metaphysical framework in terms of Necessity, the Second in terms of Chance, and the Third in terms of Evolutionary Love. I represent the First as the classical, mechanical, natural law Continuum; the Second as the complementary, statistical, field Discontinuum; and the Third as the religious context. The Third is identified and defined through the seemingly paradoxical embrace of the mutual incompleteness of the other two – the deterministic, objectivist metaphysical frameworks.

Peirce's reasoning, as well as my own, recapitulates the Socratic path to a similar moral context: the embrace of the mutual incompleteness of the Parmenidean and Heraclitean metaphysical frameworks literally defines a new *type* of problem context where the core question of moral design – How should we live? – is meaningful.

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He taught full-time at Linfield College for five years (courses include: Philosophy; Professional Ethics; Informal Logic; and The Political Environment of Health). He was President of the local Columbia-Willamette Chapter of Sigma Xi and has been involved in medical research and published several scientific papers.

He earned a B.A. in philosophy in 1969 at the University of California at Berkeley and completed four years in a Ph.D. program at the University of London in History and Philosophy of Science. His intellectual mentors were Paul Feyerabend and Imre Lakatos.

Paper Text:

Preview of the Strategy

In Part One I argue that the Scientific Hypothesis in the West begins with Thales and culminates with Parmenides rigorous formulation of the Scientific Metaphysics. Concerns as to the incompleteness of the Scientific Metaphysics lead the ancients to counterpoise the Parmenidean and Heraclitean metaphysical frameworks. Following Plato, in his dialogue *Parmenides*, I argue that these two metaphysical frameworks are interdependently incomplete and as a consequence the natural question as to which one correctly, universally describes reality is, paradoxically, undecidable. This leads us to what I refer to as the Dialectical Dilemma. There is nothing directly about the religious context here. The direct opponent of the scientific is not the religious but something Heraclitean – a universe that is irreversibly historical and geographically non-linear, and yet in a novel, stochastic sense still deterministic.

In Part Two, following this interpretation of the ancient metaphysical dialogue, I present a roughly parallel representation of the modern era. The Scientific Hypothesis is alive and well. An early, yet rigorous formulation re-emerges with Descartes. I review the modern history of the Scientific Hypothesis focusing on the core metaphysical issues. I conclude that within modern science, the mathematics and the logic of the two core metaphysical frameworks have been shown to be inherently incomplete and complementary. The question of 'the winner' is paradoxically undecidable. The result is a metaphysical standoff closely reminiscent of the ancient Dialectical Dilemma of the Parmenidean and the Heraclitean.

What I refer to as the Dialectical Dilemma, both ancient and modern, is self-referentially paradoxical. It is the paradox of metaphysical paradoxes. You can't resolve it and yet you can't avoid it. To accept it and take it seriously, forces one to reflect on the very nature of our self-concept and our assumptions about what we are doing as actors and inquirers in the universe.

In Part Three I offer a resolution of the Dialectical Dilemma within a Third metaphysical framework. I am inclined to call the Third metaphysics, The Middle Way, in a sense that it arises 'between' the original two incomplete complements. The First and Second complementary metaphysical opposites become special or limiting cases within the more general Third metaphysics of the Middle Way.

It is in the Middle Way that we find the essential moral order of the religious context. The relation between the three metaphysical positions appears to match what C.S. Peirce referred to as First, Second and Third.

Part One – The Ancient Dialogue

Thales of Miletus, in the sixth century BCE, is commonly accepted as the first person in the West to formulate the Scientific Hypothesis: that all the phenomena of the universe are governed by a universal order. The reasoning in defense of the hypothesis is

that there is an observed regularity in nature.[1] Fire is regularly hot; water is wet and regularly runs downhill, stones are regularly hard. These regularities are not only observed now, but are reported by many generations to have been observed in the past. This suggests invariance over time. Furthermore, the same regularities are found to hold in different places – when one travels to Egypt or Mesopotamia. This suggests invariance over changes in location. These early Greek scientists were very clear and explicit as to what they were saying and about what the world might look like if phenomena were not governed by regularities. Horses might give birth to people, water might be wet one day and dry another, run uphill in Egypt and downhill in Greece, objects might randomly pop into and out of existence and so forth.

The Scientific Hypothesis may be thought of as a generalization from these observations. Stated another way the Scientific Hypothesis is that all phenomena in the universe are governed by a universal time-space invariant order. This is slightly redundant since what Thales means by 'universal' simply *is* invariance over all time and all space. The same laws operate everywhere and for all time. The same laws operated in the early moments of the universe as operate today – invariance over time. The same laws govern phenomena everywhere – invariance over space/location. Galileo's experiment dropping the iron balls from the tower in Pisa in the 16th century can be performed today in Philadelphia in the 21st century with the same results. The laws governing phenomena, the relations, are the same, invariant over changes in time and space.

In simpler terms the Scientific Hypothesis is to equivalent to the scientifically common sense notion that scientific discoveries are repeatable. The entailment that scientific truths are repeatable says that what is demonstrable at one time and place is repeatable later in a different location. This simpler formulation helps us bridge the ancient and modern formulation of the Scientific Hypothesis. 'Repeatability' captures the metaphysical commitment of the Scientific Hypothesis.[2]

However, acceptance of the Scientific Hypothesis (SH) is clouded by the fact that not everything appears – at least initially – to occur regularly. Many observations appear to occur irregularly. Some things seem to work differently in different places. The same cause doesn't always appear to produce the same effect. The gives rise to the Scientific Research Program (SRP). The SRP is the systematic investigation of the time, place and circumstances of causal relations tracking down and resolving apparent irregularities into their real underlying regularities. The enormous success of the SRP, not just in discovering new regularities, but in resolving apparent irregularities into underlying regularities (viz. literally explaining away apparent counter-evidence) has led to considerable confidence that SH is true and that the SRP will indeed arrive eventually at the Theory of Everything – a formulation or understanding of the complete and

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[1] The regularity of the celestial realm may have been an earlier inspiration to such thinking.

[2] There were other science-like traditions. What I am following here in the dominant mathematical tradition that re-emerges with Descartes as "modern science".

consistent, universal order governing all phenomena. The Theory of Everything fulfilling the Scientific Hypothesis refers to the universe as a Continuum – a complete and consistent order.

Parmenides of Elea produces what, in Plato's time, is the first rigorous formulation of the Scientific Hypothesis. This was a sort of Euclidean-style axiomization where he looks for the minimum of essential definitions and principles and then draws out the implications and entailments. Parmenides emphasizes that what is meant by 'universal' is invariance over time and space. What is perhaps less obvious – although it was clearly perceived by Thales and others in the tradition – is that this defining commitment to invariance is equivalent to a fundamental commitment to symmetry. Symmetry just means 'same' – the same over locations in space and time.

Homogeneity of the substratum is another way of saying that the substratum is symmetric. What ever you do to it, however you experience it, it is always the same everywhere and always. In other words the homogeneity of the order governing the phenomena entails the homogeneity of what the order governs – the substratum. The contradictory alternative would be a universal order that wasn't applicable everywhere – to all *types* of phenomena. Or equally unacceptable some types of phenomena that might not be – by their very nature – governed by the universal order. Parmenides concludes that there cannot be a plurality of *types* of phenomena.

Parmenides pushes this line of reasoning to a sort of culmination or limit, concluding that acceptance of the Scientific Hypothesis entails that the universe is One. The One is universally symmetric, the same everywhere and for all time; universal sameness. Imagine this as an absolutely timeless infinitely small, mathematical point. But then you must take a further step and imagine your self inside this volumeless point. In modern jargon the best image is what modern physicists refer to as "a naked singularity".

This is what you should expect to come to as the culminating insight of the Scientific Research Program. According to Parmenides this is Reality. He asserts this despite the appearance of irregularities and differences. Recall that these irregularities and differences are all supposed to resolve into regularities. Central to Parmenides derivations is this extrapolation of the reasoning of the Scientific Research Program – resolving the appearance of irregularities and differences over changes in time and location into underlying regularities. In the end – at the limit so to speak – is complete and consistent symmetry, the Parmenidean formalization of the Scientific Continuum.

Parmenides directly addresses the status of the appearances of irregularity in time and space and appearances of inhomogeneities in *types* of phenomena (viz. in the continuity of *type* of the substratum). He says they are illusions – 'mere' appearances.

This begins what I refer to as the Appearance-Reality Game.

In the Appearance-Reality Game, complementary metaphysics, each positing an essentially different nature to real phenomena, argue that the phenomena posited by the other metaphysics are merely appearances, whereas their phenomena reflect reality. It's a fun game. It is a winner takes all – universality – game. Universality is violated if you allow any phenomena of the other metaphysical *type* to be real. The Parmenidean Continuum cannot allow any 'change' or 'difference' to be real.

Another way of formulating Parmenides' conclusion is to say that he insists that Reality under the Scientific Hypothesis is a *complete and consistent* sameness – One. This is the final, *complete* resolution of the appearances of irregularity into a *consistent* regularity – the endpoint of the Scientific Research Program.[3]

The Parmenidean universe both in terms of its mathematical logic and its physical reality is a Continuum. It is continuously the same everywhere and for all time; it is homogeneous in space and time. It is universal. It is the same reality from all (correct, non-illusory) points of view – objective.[4] Everything is the same, everything is constant. "There is nothing new under the sun."

The Heraclitean Metaphysical Alternative

The ancient metaphysical counter-point or complement, to the Parmenidean position is commonly associated with Heraclitus. When Parmenides says 'there is nothing new under the sun', Heraclitus responds that 'the sun is new every day'. Parmenides says that reality – the One – is universally constant and undifferentiated. Heraclitus says that the only universal is change and difference (viz. or the unending process of differentiation). This advances the Appearance-Reality Game. Both Parmenides and Heraclitus claim universality. Each posits a continuity of a different type.

This can be confusing. Parmenides posits a universal sameness – homogeneity or continuity of sameness in time and space. Heraclitus posits the opposite, a universal difference – homogeneity or continuity of difference in time and space. The Heraclitean position can perhaps be restated as positing a heterogeneity or discontinuum in time and space.

I believe it is helpful in understanding these frameworks and their relationship to speak of the Parmenidean as a Continuum and the Heraclitean as a Discontinuum, although we must not lose track of the fact that each is claiming a universality, a continuity of *type*.[5]

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[3] It is worth noting that the Symmetry, or sameness, applies to both apparent differences in phenomena over changes in *both* time and space.

[4] Notice further that the illusions – the perceptions of difference and change – are associated with the qualitative relativity of the human observers.

[5] There is potential deep confusion here, discussed by Plato in the relevant dialogues, in speaking about 'sameness' and 'difference' as *types*. For instance, sameness could be thought of as absence of types – with only one type the sense of the concept/term 'type'

The Heraclitean universe is difficult to model. But I think it is extremely important to try to characterize it. One strategy is to define its properties *via negativa*: by attributing to the Heraclitean universe the opposite properties from the Parmenidean. The Heraclitean universe – the metaphysical Discontinuum – is continuously non-Parmenidean – completely and consistently non-Parmenidean. The Heraclitean universe has those characteristics that the Parmenidean does not.

Heraclitean Uniqueness

First of all, whereas all points in space and time are the same (symmetric) in the Parmenidean, in the Heraclitean universe every point in space and time is different – and not just a little bit different but completely, uniquely different. In other words, every point in space-time is unique. Every location in space is really a location in space-time and is unique. It is interesting that this seemingly abstract characterization accords with common sense.

In whatever room you may be sitting, every location in that room is unique in space-time. Every conversation between two people is unique – it never happened before and can never happen exactly the same again. The Heraclitean substratum – the "stuff" of the Discontinuum – is completely and consistently unique; everywhere. Notice that this is necessarily the case over changes in time, so that we can also say the 'time-evolution' – what comes next – from any given point in space-time is also unique. In other words, the Discontinuum is unique in every "location" in space-time, and each of these unique moments evolves to the next moment uniquely.

We must conclude that any two 'contiguous points' in the Discontinuum are unique. In fact, any two points whether contiguous or not are unique. Assuming for the moment that it makes sense to break this down in terms of special and temporal components, any two points 'next to each other' in space are unique. This can be understood as saying that the entire substratum – the "stuff" of the Discontinuum at any instantaneous moment – is completely and consistently non-homogeneous (viz. where homogeneity is defined initially in Parmenidean terms); uniquely different. Similarly, any two points 'next to each other' in time are unique. And this can be understood as saying that the substratum – the "stuff" of the Discontinuum at *each* instantaneous moment – is completely and consistently non-homogeneous *everywhere* (viz. where homogeneity is again defined initially in Parmenidean terms); uniquely different.

One consequence of viewing the universe as a discontinuum is that the Parmenidean claims of natural law – same cause, same effect – become, at best, subjective idealizations – in reality illusions; mere subjective appearance. The reason for this is straight-forward: no two experiments or experimental trails are ever the same. There is no repetition. Repetition is an idealization, and, strictly speaking, an illusion. Repetition is a *subjective* construct that is not representative (in *type*) of reality.

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is lost. Difference could be thought of as the presence of all types – but necessarily 'developing' in that the potential types are infinite (viz. or are they?).

The inductive logic of the Parmenidean universe doesn't apply here. The suggestion that the Galilean experiment in 16th century in Pisa can be repeated in 2006 in Philadelphia is – in a Heraclitean universe – simply absurd. There is a fundamental logical disconnect. The logic of the Parmenidean universe and the logic of the Heraclitean universe are incompatible.

Whereas everything 'real' in the Parmenidean universe is repeatable, nothing in the Heraclitean universe is 'really' ever repeated – or repeatable. The Heraclitean universe then, we might say, is essentially historical – with an emphasis on 'essentially'. Moreover, emphasizing the spatial uniqueness of the Heraclitean universe, whereas space is completely undifferentiated in the Parmenidean, we must conclude that space, in the Heraclitean universe, is essentially geographical – again with an emphasis on 'essentially'; completely differentiated (differentiating).

I may be on the leading edge about this next point[6] but it fits well into the overall picture. What I believe is that the Parmenidean space-time is Newtonian and the Heraclitean space-time is Einsteinium or relativistic. In the Parmenidean and Newtonian systems a change in space – a difference in location – does not entail a change or difference in time. Time is simultaneous throughout space. That really defines space for Newton and presumably Parmenides. On the other hand, every change of position in space in a Heraclitean system is a change of position in time. There is no simultaneity – no sameness of time. This gets a little weird however, because in a Heraclitean system there is no sameness of space either. But the contrast and apparently complementarity is intriguing. To say that there are no two places in the Heraclitean universe where one could say that it is the same time – sounds like saying that there is no simultaneity. And since what Newton meant by 'space' entailed sameness of time – one should say that there is no Newtonian-type space in a Heraclitean universe. This is equivalent to saying that there is no Newtonian-type preferred time frame in a Heraclitean universe. To say that there is no Newtonian-type space in a Heraclitean universe entails by similar reasoning that there is no Newtonian time – no simultaneity.

The complementarity of the Parmenidean and Heraclitean representations of space-time, apparent in these arguments, is what is intriguing. Newtonian space-time and Einsteinian relativistic space-time (viz. and the possible types of phenomena that can occur (viz. be 'real') in each) are complementary. In other words, I am hypothesizing that Heraclitean space-time is relativistic. It seems to me that this sort of metaphysical examination can potentially clarify both the nature of relativistic space-time and its correct relation to Newtonian space-time. It should not be surprising that the arguments parallel the relation between Euclidean geometry and Non-Euclidean geometries. The incompleteness of the Euclidean geometry, metaphysically Parmenidean, leads to exploration of the Non-Euclidean geometries. Less well appreciated in the fact that the

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[6] Bohr and Kuhn both argue for this position.

incompleteness of the Non-Euclidean geometries leads us back toward the Euclidean – and to a dilemma.[7]

In this same line I want to suggest here that the Heraclitean space-time might be reasonably represented as essentially non-local – where 'locality' is initially defined in Parmenidean terms. So the thought that 'non-locality' is a possible attribute of the Heraclitean Discontinuum is reasoned, or imagined, by *via negativa* reasoning.

Real change or difference for each of these continuities would be a discontinuity of *type*. In a time-symmetric continuity, real change would be a symmetry-breaking, time-asymmetric event; perhaps an irreversible process. In a chaotic or flux continuity – what I have called a continuously discontinuous continuity – described by statistical mechanics, real change would be a phase transition; perhaps a non-equilibrium process. Modern chaos theory that envisions a world of naturally emergent complexity encounters the problem of how to account for the existence of sameness and simplicity.

To the extent that these two metaphysics claim a universality of type, they are unable to account for the real arrow of time; real change and real difference.

Causality and Chance

When one reasons *via negativa* from the Parmenidean metaphysics the Heraclitean system seems more like a chaos – a flux – than a coherent universe. Recall that the causal logic of the Parmenidean is that of the Scientific Hypothesis – same cause, same effect.

In a Heraclitean universe, for any given causal state (i.e. a point in space-time) there would be no way to define the effect (i.e. its next instant in space-time) in terms of, or in relation to, the cause. They are unique. The effect must be unique in relation to the cause – essentially heterogeneous; qualitatively different.[8]

In modern terms we might suggest that the initial 'state' – although there really can't be a definite, non-dynamic state of affairs – evolves in a non-linear or stochastic manner. It is not immediately clear what this means or how it could be empirically verified. But I think, with these reservations, we should push on and see what we find.

Notice that it is as the same cause, same effect relationship begins to come apart – at least 'apparently' – that we introduce chance. When I flip a coin (the cause) – repeatedly – I find two different effects: heads and tails. With a single die – repeatedly thrown – I observe six different effects. As I increase the number of dice or the number of sides on each die, I observe an increasing large set of outcomes. Consider a die that has many, many sides. Taking it one step further, let's move all the way to the limit where the die becomes a sphere with – in effect – an infinite number of different points of

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[7] From a Non-Euclidean framework is it entirely unclear why the universe appears to be, and indeed, is empirically confirmed to be, quite Euclidean.

[8] The idea that change in the Heraclitean system is qualitative change is plausible.

contact (i.e. 'sides'). If we postulate that every point in space and time in the Heraclitean model had the nature of that spherical die – continuously changing (viz. being thrown) so that instant to instant any one of the possible points of contact might be next, then we approach – but perhaps not yet reach – a valid Heraclitean model of universal change and difference. One way to describe this situation is to say that for each point in space-time – each initial causal 'state' – there is an equal probability that any one of the unique, possible 'states' follows – is the effect.[9]

This is a sort of stochastic causality – ideally at a state of thermal equilibrium. It is a characteristic of the state of thermal equilibrium that the relation between any two potential states is equi-probable.

The difficulty in reasoning *via negativa* from the Parmenidean is that there are solid reasons to suspect that the concepts and 'type' of phenomena themselves in the two metaphysical systems are essentially different – incommensurable. Complementarity is the argument that these really are differences for which there is no common denominator – no basis for a formal/ logical/mathematical translation of one into the other.

The defense of the notion that two phenomena – and their corresponding metaphysics – can be complementary and incommensurable is the business of the incompleteness proofs. What is important to emphasize here is that claiming that the Heraclitean universe, characterized *via negativa* from Parmenidean concepts, has chance-like, non-local phenomena, or looks like it is governed by chance, just means that it doesn't make sense in Parmenidean terms. What I am more comfortable saying is that the two metaphysics have different concepts of what a phenomenon is, different logical rules and different mathematics.

What looks like it doesn't make sense in terms of one way of looking at it doesn't entail that it might not make sense in another way of looking at it. The Scientific Research Program resolves 'apparent chance' interpreted as uncertainty into causal order. But if the Scientific Hypothesis isn't complete and consistent then we should expect real chance-governed phenomena that will never resolve into the Scientific Hypothesis-type order. These constitute objective chance – an irreducible probabilistic aspect of the universe. Looked at in another way they may be understandable in terms of a different *type* of order. For instance, it is reasonable to speculate that a Heraclitean universe will look chance-like from a scientific point of view, but may have a perfectly intelligible narrative description from another point of view.[10]

The Nature of Change

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[9] An image I like here is to think of the initial, causal state as a completely localized electron and the effect, the subsequent state as a completely non-localized state – probabilistically distributed in space-time. But of course the initial state here is Parmenidean – which can't occur in the Heraclitean space-time.

[10] Some sort of 'design' is the common proposal.

What is meant by 'change' is different in the Parmenidean and Heraclitean metaphysics. This is a consequence of saying that the Continuum and the Discontinuum define different types of space-time and different types of phenomena.

What is meant by a phenomenon – an observable – differs in each metaphysics. Consider asking: What is a phenomenon? An observable? A fact? There are these two types of possible answer, but the question – asking for a definitive, objective answer – is undecidable.

Change in a Newtonian-Parmenidean universe is, always and everywhere, symmetric. In this sense there is never any '*net*' change. All types of change are time-symmetric. All types of 'real' change must also be spatially symmetric. One can grasp this in the cosmological image that all time and all space – as well as all charge and mass (in terms of $E=mc^2$) must add up to zero. More literally it always is zero – Parmenides' One – the absolute symmetry entailed by Thales original Scientific Hypothesis.[11]

Change in the Heraclitean universe is non-linear and non-symmetric (as reasoned from our *via negativa* characterization of the Heraclitean). Causality in the Heraclitean universe – again starting from Parmenides and reasoning *via negativa* – is statistical or stochastic. There are no 'forces' in the normal Parmenidean sense driving the system, for instance, from non-equilibrium to equilibrium.

Change in the Heraclitean universe is non-symmetric – continuously (viz. completely and consistently) irreversible – essentially historical and geographically chaotic.

Notice that being historical in this Heraclitean sense doesn't suggest anything about being teleological. The Heraclitean history is as deterministic, universal and objective in its terms as the Parmenidean is in its terms.[12]

Causality in these two metaphysics seems to be linear and non-linear. The latter is a sort of stochastic causality.[13]

The Appearance-Reality Game

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[11] There is a comparable image in the Statistical Mechanical model of reality – associated with the Heraclitean-type universe. Here the statement would be that the universe is 'really' always in a state of thermal equilibrium. This is due to the universality assumption of complete and consistent discontinuity. It can't allow any non-equilibrium states to be 'real'.

[12] This is reminiscent of modern chaos theory. Mandelbrot, when visiting the Institute for a lecture, allowed me to suggest, in the introduction, that the cosmos might be viewed as evolving chaotically – generating fractal patterns. But he declined to assert and try to defend this himself.

[13] Mortensen, Chris, "Change", Stanford Encyclopedia of Philosophy (2002) http://plato.stanford.edu/entries/change/

The representation of the dialogue between Parmenideans and Heracliteans as an Appearance-Reality Game displays the way in which each of these frameworks attempts to "explain away"[14] as appearances precisely those phenomena that the other takes to be real.

What this reflects is the curious relation – or non-relation – between the types of phenomena considered real by the Parmenideans and the type of phenomena considered real by the Heracliteans.

Heraclitus offers the image of the river to illustrate the nature of objects. The river is real and yet "you can't step in the same river twice". The river is not to be identified with the specific material flow at any given time. Arguably the material content of the river in any given section, or overall, or on any given day, is never the same. And yet it is the same river. To advance the comparison think of the material flow – the water – initially, as composed of 'atomic' water particles.

Continuing the Heraclitean side, notice that people are like rivers. We know by using radioactive tracers that the material content of our bodies (every type of atom and every molecule) changes completely every seven years. In a seventy-year life span our material content is completely replaced ten times. The water molecules in our bodies are completely replaced every eighteen months. And yet it is the same person, like the same river.[15]

If we are not to be identified with our material – what are we? One modern suggestion might be that we are some sort of organization defined by our genetic material.[16] The ancients and moderns might agree that humans are a certain type of organizational system (viz. dynamic structure; dynamic equilibrium). One must add however that each individual human is unique – a sort of token of the type.

Plato talks in terms of a *form*. I also like the notion that the 'form' can be thought of as 'that to which the concept corresponds'. The form *human* is that to which the concept *human* corresponds.

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[14] Chalmers, A.F., What is this thing called Science?, (1978) Open University Press

[15] A stubborn Parmenidean can of course just deny that it is the same person. Following up on this requires broader consideration – such as memory, personal identity, etc. – than called for here.

[16] This isn't really helpful since we know now that we have numerous mutations during our lives. But the system is robust, so that most of these don't kill us. Furthermore it is unlikely that we would say that a person was not the same person after receiving some sort of genetic engineering therapy that altered – corrected or enhanced – some aspect of a person's body. Weigh-lifting to add muscle tissue isn't likely to lead us to say that it is a different person, even though the material structure and specific composition have changed.

And it is not just humans; all living organisms have this same 'flow through of material while retaining form' characteristic. The Earth's biosphere and the planetary ecosystem have the same characteristics.

What I want to emphasize here is that a committed atomistic Parmenidean does not need to accept that these phenomena – these forms – are real, or that they exist as such. Indeed, it is not clear that he could do so consistently even if he wanted to. There is simply no correspondence between biological forms and the material reality of a Parmenidean atomist. The notion that you can simply construct the 'higher (macro) forms' from 'lower (micro) atoms' is simply mistaken. But if that is the case, then what is the status of the 'supposed' atoms from a Heraclitean point of view.

First of all a thoroughgoing Platonist with a Heraclitean bent would argue that everything that you can see – in the sense of 'understand' or 'makes sense of' (viz. whatever is 'intelligible') – is really like a river or biological organism, having the nature of the forms. This includes molecules, atoms and even elementary particles. Modern science confirms that the elementary particles too are intelligible forms absorbing and releasing a flow of 'energy'. This can be taken all the way down – to provide a Heraclitean re-interpretation of any measurable 'atom' of whatever form.

Parmenideans and Heracliteans might leapfrog their way downward into the micro world trying to determine whether the underlying reality – final substratum – is eternal, material atomic units (particles) or stochastic energy-transfers. The Copenhagen Interpretation of Quantum Theory argues that the issue of the nature of the substratum – whether Parmenidean or Heraclitean – is undecidable. A thoroughgoing Parmenidean is going to argue for some sort of atomism. Lucretius serves to illustrate: "there is nothing but atoms and the void." The void here is space-time – or more abstractly, the 'possibility space' that defines how the atoms can permute their arrangements. Earth, water, air and fire were distinct only in their density of atoms according to some of the thinking in these early atomic systems.

The crucial point here is that from this atomistic, Parmenidean perspective the things the Heracliteans *see* as realities – the forms – are like patterns one might imagine one sees in the formations of clouds. The modern song "Both Sides Now" sung most famously by Joni Mitchell captures this, where she recalls seeing images in the clouds of "ice cream castles in the air". Clearly these and all other Heraclitean experiences of 'forms' must be judged by the Parmenideans as entirely subjective – as illusions – they are not really there. Surely the pattern is *there* but it is nothing *really* other than atoms and void. Even in cases where the pattern persists – like a swirl in the river – "the swirl" is not anything but atoms and void. The swirl is not *really* there, because it is not materially – in terms of atoms – the same from moment to moment. Even its shape as a swirl is fuzzy and indefinite. All "appearances" of Heraclitean-type forms are subjective – what Parmenides called 'opinions' – or simply illusions. All the Heraclitean phenomena/observations/experiences are re-interpretable, reducible to atoms and void. The 'arrangements' of atoms in the void are themselves not 'real' since when understood

and viewed properly, in terms of their regularities; they will – in the overall – be entirely symmetric.[17]

Without trying to sort out all the points and counterpoints the Parmenidean-Heraclitean opposition can be productively represented as dueling theories of the nature of the substratum – either as 'atoms and void' or as 'stochastic energy-transfer'.

A process – characterized through our *via negativa* reasoning – begins to look like a non-linear, probabilistically distributed (non-local), stochastic (or chance-governed) field. The field – particularly to a 'pure' Heraclitean – is not a bunch of atomic particles bouncing around according to a linear, Parmenidean causality.[18] There are no particles in the Heraclitean universe because it is a 'particle-discontinuum' – continuously non-particulate, by its very nature.[19]

The value of this exploration is not so much to convince the reader of matters that quite reasonably require considerable citations of published experimental demonstrations. Rather the value is to illuminate the metaphysical underpinnings of what one might otherwise take to be a matter that could be understood within, or on the basis of reasoning from, one or the other of the metaphysical frameworks exclusively. The nature of the phenomena, the logic and the mathematics required cannot be supplied exclusively by either alone.

One of my favorite ways of expressing the AP Game is to say that each side attempts to subsume the other – swallow it – but each lacks the logical enzymes to digest the other's phenomena (experiences).

There is nothing one can say to convince the Parmenidean that Heraclitean-oriented science[20] is anything other than immature Parmenidean science. Basically all macro-science must really be micro-science. How the so-called forms behave will eventually reduce to the behavior of the atoms in the void.

But this Parmenidean reductionism works if and only if the type of phenomena represented by the forms corresponds in some way to the type of phenomena represented by the atoms. And we have just argued that these are not commensurable (homogeneous) types. One occurs in the Parmenidean Continuum and the other type occurs in the Heraclitean Discontinuum.

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[17] This can be clarified by reference to Newton's Third Law.

[18] I am of course suggesting that the standard notion that the field as 'merely' an ensemble of particles – as in Boltzmann's model – doesn't work.

[19] I suspect that another good way to say this is that the particles are all non-local – probabilistically distributed, and, moreover, non-interacting in a Parmenidean-way – meaning that they are not interacting in a linear way. This is equivalent to saying that they are behaving randomly – governed by a sort of stochastic causality. Sound familiar?

[20] This would be a probabilistically grounded science; perhaps like quantum field theory.

Incompleteness and Undecidability in the Ancient World

In Plato's dialogue *Parmenides* the competition between the Parmenidean and Heraclitean metaphysical frameworks is the central topic. The dialogue explores four theses – each evaluated in terms of each framework. The inadequacy of a thesis associated with the Parmenidean implies that the Heraclitean must be correct. But then the thesis associated with the Heraclitean proves inadequate implying that the Parmenidean is correct.

In the first part of the dialogue Socrates attempts to defend a third position resolving the monism-pluralism standoff. I argue later that this third position corresponds to Peirce's Third metaphysics.

The concluding section is finally summarized as follows:

> *"Let thus much be said; and further let us affirm what seems to be the truth, that, whether one is or is not, one and the others in relation to themselves and one another, all of them, in every way, are and are not, and appear to be and appear not to be."*[21]

In another translation there is a non-literal concluding statement by Socrates:

> *"Well, then, I guess we can't say anything."*

The central issue of the dialogue relevant to this essay can be stated in terms of a question of completing the following sentence: The universe is X. Where 'X' can take only one of two possible values: a) same/constant, or b) different/changing. What we are asking for is the correct predicate that describes the 'real' universe.

The question of whether the universe is universally, objectively constant or changing is undecidable. That is why Socrates concludes that we can't say anything – without leading into self-contradiction. The term 'undecidable' is from modern 20th century jargon related to proofs of incompleteness of formal systems. What I am arguing is that the *Parmenides* reflects the ancient experience with formal undecidability.

Plato's *Parmenides* is an argument for the mutual incompleteness and self-inconsistency of the Parmenidean and Heraclitean metaphysical systems. I have not presented the detailed arguments of the dialogue. My purpose here in more by way of placing a marker and a note that the ancients dealt with incompleteness, undecidability and paradox. This didn't begin in the 20th century with Russell and Whitehead and Kurt Gödel. These two metaphysical systems are intimately intertwined, inter-defined, in the sense that talking about Sameness (Continuum) without meaningful reference to Difference (Discontinuum) and vice versa, just doesn't work. Any push to claim one or

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[21] Plato, *Parmenides*, in *Plato's Parmenides* (Albert Keith Whitaker trans.) (1996) Focus Philosophical Library.

the other as the 'real' (objective, universal), unifying framework is certain to be self-inconsistent. Subsumption of one by the other is inevitably paradoxical.

Socrates pushes for a solution in the direction I am indicating, suggesting that there is a self-referentially consistent model of reality, a third type of metaphysics.

The Pythagorean Paradox

One of the most important arguments for incompleteness of the Parmenidean metaphysics, appreciated by the ancient, is what I call: The Pythagorean Paradox.

The Pythagorean Paradox is a consequence of the famous Pythagorean Proof that the sum of the square of the two sides of a right triangle is equal to the square of the hypotenuse: $a^2 + b^2 = c^2$, where a and b are the sides and c the hypotenuse.

One consequence of this relationship is that the diagonal of the unit square is incommensurable with the two sides: a = 1, b = 1, so the sum of the squares of these is 2, so c equals the square root of 2; an irrational number. What this shows is that there is more than one type of thing in any mathematically definable universe: a and c are inhomogeneous. This shows in effect that the substratum is not homogeneous, violating the core symmetry of the Parmenidean metaphysics and proving the incompleteness of the Scientific Hypothesis.

I find it curious that this has been to under-appreciated in the modern era. The modern path to roughly the same conclusion came – mathematically – through Non-Euclidean geometry.

To understand the significance of the Pythagorean Paradox it is essential to see it presented as a paradox – something that you didn't see in your high school geometry class, but that could easily have been reasoned.

The 'traditional' proof that the diagonal of the square is incommensurable with the side is given in an appendix to Euclid, Book X, and may be paraphrased as follows:[22]

Let AC be the diagonal of the unit square, AB its side.
Suppose AC is commensurable with AB, and let *a:b* be their ratio expressed in the lowest terms.[23]
Since AC > AB, a > 1.
Then AC:AB = a:b
So $AC^2:AB^2 = a^2 : b^2$
But (by Pythagoras' theorem) $AC^2 = 2AB^2$
Therefore $a^2 = 2b^2$

[22] A History of Greek Mathematics, Vol. 1, Oxford, Clarendon Press, 192 1, pp. 246

[23] This assumption that the ratio is expressed in lowest terms is a subtle yet crucial statement in understanding the proof.

So a^2 , and therefore a, is even, and since a:b is in its lowest terms, b *is odd.*[24]
Since a is even, let $a = 2c$
So $4c^2 = 2b^2$
So $2c^2 = b^2$
From which it follows that b *is even.*
Since the assumption that AC is commensurable with AB leads to the impossible consequence that the same number (b) *is both odd and even*, the assumption must be false.
QED

Another way to look at this is to ask the question whether the diagonal of any unit square is an odd or an even number (ratio); or specifically, whether the square root of 2 is an odd or even number (ratio). These are undecidable. The attempt to provide a rigorous proof one way or the other – logically – encounters a paradoxical expression, namely, if it is odd, then it is even, yet if it is even it is odd. This form – if A, then not-A, but if not-A, then A – is the classic form of a paradox.

What is being shown here is that Euclidean geometry is inherently inconsistent. Another way to state this is to say that the assumption built into the logic of the Euclidean geometry cannot resolve all questions that can be meaningfully asked within the definitions, axioms and logico-mathematics of the system.[25] Still another way to state the conclusion is that there are real geometric phenomena ("describables" or "conceivable reals") that cannot be understood from within the formalized reasoning of Euclidean geometry.

Still another conclusion is to simply accept that the square root of two is both odd and even; that it has both these opposite properties at the same time. This conclusion suggests that we need to expand our notion of reasoning. We need to move beyond the Law of Non-Contradiction.

The key point in Plato's *Parmenides* is of course that similar arguments can be brought against both a formalized Parmenidean metaphysics and a formalized Heraclitean metaphysics and their corresponding geometries. Both metaphysics are incomplete and the question of which one is the real, universally true framework for understanding the universe is undecidable.

Previewing the Transition to the Third Metaphysical Framework

I present here a preview of the proposed final resolution – from First and Second metaphysics to the Third. This is to be done by means of briefly reviewing the resolution of the incompleteness and undecidability paradoxes associated with Socrates and Plato in the ancient context. Following that I will develop the parallel themes in the modern era.

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[24] The a must be even because 2 times any squared number must be even. Consider 1, 2, 3, 4. And since a:b is in lowest terms it is at best 2:b

[25] I phrased this to recall Gödel's expression in his proof of incompleteness. The proof is that there are meaningful question that can't be decided.

One way to express the Dialectical Dilemma in the ancient period is to say that the claim of each metaphysical framework to universality fails. Both the Parmenidean and Heraclitean metaphysics claim to be able to explain all (real) phenomena as governed, or not governed, by one time-space invariant order, or disorder). Each metaphysics fails to articulate a self-referentially consistent logical or phenomenal framework. Each of these broad metaphysics appear to be, somehow (paradoxically) incomplete.

As a young man Socrates was an enthusiastic student of the Ionian tradition – the Scientific Hypothesis – identified as arising with Thales. However, over a period of time he became less impressed. He felt that these theories were missing something. Socrates gradually begins to realize that the scientific explanations tell us only how things happen, but not why.

The transition that Socrates makes, he tells us in Plato's dialogue *Phaedo*, comes from an encounter with the views of Anaxagoras, who shifts away from the earlier Ionians to propose that the ordering of the phenomena of nature are due to an intelligence. This intrigued Socrates. He becomes very excited about this new proposal. However, after studying Anaxagoras's system he found that Anaxagoras only wanted to have intelligence start motion and then everything was again mechanical in the Ionian sense.

However it was that he proceeded from there, the place he arrived at can be thought of as an embrace of the Dialectical Dilemma.

Socrates is famous for leading people into the Dialectical Dilemma. If someone comes to Socrates believing A, then Socrates leads him through a natural extension of A, to see that if he believes A, then he also believes its opposite or complement B. Similarly, if one starts with B, he ends up agreeing to A as well. Socrates is not interested in converting anyone from A to B or from B to A. He is interested in showing that belief in A entails belief in B; over *vice versa*. The endpoint is a sort of Dialectical Dilemma. Both A and B are true, in a sense, and yet both A and B are false, in a sense. Both A and B 'participate' as aspects of the topic under consideration.

People still thinking in either/or logic respond to Socrates as if he has defeated or disproved their belief, for instance, in A; showing it to be false. And in the sense that A had been thought to be, or exclusively represent, a complete and consistent system, they are correct. But that misses the Socratic point. Yet it is natural from this either/or perspective to ask Socrates, who seems to see that all these other beliefs about how the world works are wrong, just what the right belief is. "So, Socrates, what is the answer? How does the world work?" Socrates answers that he doesn't know. This answer can seem rather outrageous. Here the master of defeating everyone else's beliefs says that he doesn't know. Doesn't he defeat these other beliefs on the basis of the true belief? Perhaps not. But then what is happening. What is Socrates saying and doing?

Those who recognize and embrace the Dialectical Dilemma are then able to join Socrates in further inquiry as intellectual allies.

Consider a simple example of how an encounter with Socrates might proceed. Assume for the moment that one believes that the world operates competitively. This suggests of course that if one (naturally) wants to get ahead, one should act this way – competitively. (Never mind that if it *really* is the way, the natural way, the world works[26], then one shouldn't need to *try* to be that way.) Socrates might lead them to see that over time a competitive system would end up with a few winners, eventually one. One might reason that as winners advance to the next round, there are fewer and fewer real competitors. The losers continue on only as underlings, like slaves, of the winners. Eventually there is one winner – the supreme emperor – with everyone else as an underling or slave. The competition ends. The competition naturally leads to its opposite – a complete lack of competition. This seems reasonable, Socrates interlocutor agrees.

So if one really believes that competitive is the natural order and the way one should live, the best way to try to live, then – Socrates proposes – one should oppose the tendency to the eventual uncompetitive endpoint. Agreed. So if one believes that the natural and best way to live is competitive then one should both support it and oppose it. Competition and its oppose both participate in the issue. The real dilemma – if you don't feel it already – comes when one considers what to do next: support or oppose. Aristotle has an appropriate expression when he speaks of "the agony of deliberation." Accepting that, in practice, one needs to oppose the tendency of a competitive system away from real, continuing competition, at any given moment one must make *a practical judgment*.

What Socrates is after is the basis of such judgments. How does one make an intelligent judgment, if, as Socrates is positing in general, the *real*[27] universal decision context (viz. what to do and what to believe) is always of the character of a Dialectical Dilemma?

In our example those who come to Socrates have not reflected, have not examined their actions and beliefs, to discover the need to expand their concept of reason and their corresponding beliefs as to the nature of reality.

Before proceeding to further characterize the Socratic context, let me put this current representation in terms of our Dialectical Dilemma involving the Parmenidean and Heraclitean metaphysical systems. A Parmenidean might believe that the world is Parmenidean – say, governed by same cause, same effect relations that are invariant over time-space (universal; objective). And as a participant in the Scientific Research Program he believes that he is looking for these types of relations – advancing the program toward the final, complete and consistent understanding of all phenomena – as the Scientific Hypothesis asserts. However, it may be that on reflection, looking at what

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[26] Completely and consistently.
[27] Third

he actually does in the process of inquiry he will be unable to account for his successful action on the basis of the Parmenidean/Scientific framework.

It may be indeed that what he is actually looking for and successfully finding cannot be completely and consistently accounted for in terms of a Parmenidean/Scientific representation. This potential disjunct between what science says it is doing and what it is actually doing was the primary focus of much discourse in the latter half of the 20th century – crystallized for many around the work of T.S. Kuhn's book *The Structure of Scientific Revolutions*.

Just as the Scientific Research Program is always trying to understand phenomena in terms of the Scientific Hypothesis as behaving according to same cause, same effect relations, so too what we might call the Competition Research Program is trying to understand the world according to the Competition Hypothesis, namely that everyone and everything in the world is really acting competitively. If I want to really understand people's actions, I will always see them in terms of this competitive framework – despite any appearances (apparent deviations) to the contrary. I may not be able to resolve your apparently friendly and cooperative behavior into an understanding of its real competitive strategy right away, but I am not about to be fooled or taken in. (I have already recognized that those who preach cooperation are either self-deceived, or are trying to deceive others so as to gain an advantage over them.) I am able to cite many previous instances where I eventually saw the selfish intent behind what initially appeared to be friendly, supportive or cooperative behavior. People are your friends – at best – only against others and only until they have an opportunity to knife you in the back. Any attempt at real cooperation is irrational.[28]

Could it be that the world you see and experience depends on your beliefs and corresponding actions? If you think this way you will only see certain aspects of the world. If you act this way others will respond to you accordingly, some agreeing and joining you, others disagreeing and opposing you. But one way or the other, according to a Socratic model, you will participate in a system (and in yourself) in both aspects.

Notice in particular that in the Socratic context the ideal of objective reality – essential to the universality of both the Parmenidean and Heraclitean metaphysical framework is gone – albeit in a paradoxical way. How can it be that the reality that one experiences depends on one's beliefs and the type, or character, of one's actions? And yet, Socrates suggests, in some sense it doesn't. There is a reality. Coming to embrace the Dialectical Dilemma is a step toward finding it.

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[28] The Competitive Hypothesis is a type of logos or rationality. Can one make mistakes? Is it the natural way or not? How can it be that the reality that you experience depends on your beliefs and types of actions? Doesn't this undermine the notion of objectivity?

What is valuable to see here is that the Socratic response does not *oppose* the interlocutor, but rather says *incomplete*, and seeks to *expand* his understanding of himself and the world.[29]

Within the embrace of the Dialectical Dilemma, a new question becomes meaningful: How should we live? This is one of the core expressions that capture the character of the new rational context that Socrates is drawing us toward. This question is not self-consistently meaningful in a deterministic system – in either the Parmenidean or the Heraclitean. In objective, universal, deterministic systems there is no 'real' problem of deciding how one should live. But as we saw for the person who (thinks he) believes that the objective order is competitive, he is confronted with a Dialectical Dilemma – to advance or oppose competition.

Notice that we have moved from two alternative hypotheses about the way the world works (how it *is*) – objectively – to their standoff as mutually incomplete, paradoxically complementary metaphysical extremes to a new context, where the question is about how we *ought* to live, and about how the world *ought to be*. In the jargon of the modern period we have just moved from the 'is' context to an 'ought' context. We have moved from a research programs concern with 'what is true' to a research program that asks 'what ought to be true'.

The question – How should we live? – is a practical question and much of what Socrates discusses concerns practical knowledge – how to do things. But such knowledge, important as it is, isn't enough because it can be used intelligently or not so intelligently. How does one make intelligent judgments as to how to employ his potential to act in the world?

I see the question – How should we live? – as a design question. How should we design the irrigation of our fields? How should we design the construction of our houses? How should we design our cities? How should we design our economy? And how should we design a political system that preserves and develops our economic system? And more generally, how should we design out lives, treat others, and ourselves?

The catch here is that as designers of our lives we are blind as to how best to proceed. Someone forgot to provide us with the script. We can make mistakes – although it is unclear how we might know or feel or believe that we have made a mistake. We might learn from our mistakes. But what are we learning? Socrates seems to be suggesting that what we are learning is how to use our potential – our skills – for the best – to bring new good things into the world. We learn how to make intelligent judgments about how to do good things – to lead a good, indeed, better and better, life.

I want to note for emphasis several points here. Socrates moves to discuss practical knowledge. This is a break from the Parmenidean/Scientific search for "pure",

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[29] Jesus, *Bible*: "I came not to oppose the law but to fulfill it."

universal knowledge. But Socrates then notes that practical knowledge is blind as concerns it use. So having practical knowledge does not resolve the Dialectical Dilemma. We are always faced with the problem of making intelligent (rational) practical judgments.

There is a sense in which the Socratic man begins life as a blind agent. In modern terms he is an existential character, because he has the potential to act and yet has no basis for deciding/choosing how to act. But Socrates wants his character to be a sort of existential pragmatist – existentially blind, yet a participant in a practical world. There is the suggestion that even though continually existential, he can learn something that can help him make better judgments – better than random; less blind in some sense, yet by gaining more empowerment, he is even more blind (or perhaps the same blindness but with more power).

Part Two – The Modern Dialogue

In this portion of the essay I attempt to parallel the structure of the first portion. I introduce modern science as a rebirth of the Scientific Hypothesis and a reaffirmation of Parmenidean Metaphysics. The Heraclitean response is not far behind with the introduction of the field, along with irreducible chance. I argue that all these lines of inquiry have encountered incompleteness and undecidability. Besides the individual responses to the Dialectical Dilemma, there have been two important general responses: The Correspondence Principle and the Copenhagen Interpretation of Quantum Physics. Once these are briefly reviewed and clarified I argue for a resolution in the Third Metaphysics.

Modern Science

The first formal statement of modern science is commonly attributed to Rene Descartes in his Mechanical Philosophy. Galileo Galilei and Johannes Kepler represent earlier, less formal statements of the modern Scientific Research Program. Galileo affirms the Pythagorean theme that the language of nature is written in mathematics – Euclidean geometry in particular. Kepler's discovery of the laws of planetary motion establishes the cornerstone – the paradigm. Descartes unification of geometry and algebra in his trigonometry provides a general set of tools for the research program Galileo and Kepler had demonstrated piecemeal.

Descartes is a modern Parmenides. The Mechanical Philosophy clearly separates the objective and the subjective, axiomatically. Descartes discussion of the mind (res cogitans) as a separate type from what is found in space (res extensia) is an exclusion of mental language from nature. The modern era, even up to the present, is littered with failed attempts to reintroduce intelligent agency into the 'real' world – without rejecting the beneficial and clearly successful results of the Mechanical Philosophy and its research program.

Objectivity means that reality is the same for all observers, from all points of view, in all frames of reference. The truth should look the same (present itself the same) to all observers. Uniformity of nature also means uniformity of observational frames –

ways of looking at reality. The Scientific Hypothesis defines *the way*. To the extent that qualitatively distinct frames or perspectives are proposed, they are inevitably associated with value (viz. a qualitative type of difference is a difference in value). Consequently, the objective world is value-free or value-neutral. This is another way of saying that the substratum is homogeneous – and for the Parmenidean metaphysics this means the one quality or type, which is the non-quality type (viz continuously quantitative; Pythagorean). In other words the substratum of the objective world is to be understood in completely mathematical terms – as a quantitative Continuum.

The Mechanical Philosophy is the modern version of the Scientific Hypothesis and is based on the Parmenidean Metaphysics. What Descartes has done is to takes the demonstration of same cause/same effect and generalize it over space and time – to propose a system for understanding all the phenomena in the universe as governed by one complete and consistent, universal, objective, time-space invariant order.

Laplace develops the entailment of all phenomena being governed by natural law. The ability to predict the trajectories of particles with reasonable precision from a set of initial conditions by means of logico-mathematical laws came to be the defining, paradigmatic characteristic of modern science. In this vein, Laplace identifies causality and deterministic prediction. "All the effects of Nature are only the mathematical consequences of a small number of immutable laws."

When one looks forward in time as well as back in time there is continuity, a homogeneity, a symmetry. An extreme, metaphysical interpretation is that every state of the universe – forward and back in time – is symmetric, the same.

Chance in the Modern Scientific Model

There is an important connection between the relegation of the subjective to the world of appearances and illusions and the treatment of chance. Chance is the opposite objective law. To say that phenomena are governed by laws is to say that they are not governed by chance. As I mentioned earlier there are two different conceptions of what a real phenomenon is. One type of phenomenon – the scientific type – is, by its very nature governed by time-space invariant laws; natural law: same cause, same effect. If a phenomenon 'looks' like it is partially governed by chance, then you must conclude that this is subjective uncertainty. Your vision or observation is confused or somehow out of focus. You haven't correctly understood the experience, or perhaps the experimental setup. When you see things as they really are – and same cause, same effect can be demonstrated – then you see (understand) the phenomenon correctly; clearly and distinctly.[30]

The general scientific theme is that the 'appearance' of chance behavior among the phenomena of the world is not 'real' or an experience of 'reality'. It is subjective, due to an 'incomplete experience' – like a misunderstanding. It is due to a subjective

[30] This is what I think Descartes was after when he spoke of true experiences being 'clear and distinct'; no fuzzy uncertainty.

lack of knowledge or understanding. All the uncertainty that one experiences is due to personal, subjective ignorance and does not reflect anything about the ultimate underlying reality that full knowledge and understanding would reveal. This uncertainty that is experienced as chance must be resolvable – if not immediately, or relatively soon, at least in principle. Part of the normal activity of practicing experimental scientists is to manipulate what appear to them to be relevant factors in an attempt to get a 'clean' or at least 'cleaner' link between their observation of one specifiable cause and its observable, one specifiable effect.

'Apparent' irregularities that arise in a world hypothesized to be completely and consistently regular introduce chance. But this chance must be subjective, illusion, due to my incomplete knowledge or understanding of the world.

The standard image of the litany of the Scientific Research Program is that our overall uncertainty, and corresponding experience of chance, will decrease with as knowledge increases – along with our observational technique. Through the SRP we are converging on the truth – the truth of the Scientific Hypothesis.

Chance and Incompleteness

But what would it look like if the experience of chance were 'real'? It would mean that there were real differences and that there was real change. Real difference and real change would constitute discontinuities in the postulated Continuum of the Scientific Hypothesis. Real chance would be a discontinuity of the continuity *type* defined by SH. Real chance would constitute something like a demonstration of the metaphysically opposite *type* – a qualitative change or difference. This would be a qualitative difference in a world that is supposed to be continuously non-qualitative, a world that is supposed to be completely and consistently describable in terms of linear mathematics.

Whether you are reasoning in Parmenidean or Heraclitean metaphysics, the experience of real change or real difference will be in relation to *your* hypothesized *type* of continuity. In both cases the experience of real change and real difference is a breaking of the continuum-type. It is symmetry-breaking of the type of symmetry that each proposes. Change or difference in a Heraclitean Discontinuum is simply a discontinuity of the discontinuity – an unexplainable continuity of the Parmenidean type. What I am pointing at here – previewing – is that real change and real difference can't be accounted for by either metaphysics by itself. This is part and parcel of the Dialectical Dilemma and the Third resolution. If either of these two metaphysics were correct then there would be no real change, and there would be no real time.[31]

It is unclear how one could ever convince a thoroughgoing advocate of SH and participant in the SRP that some experience of chance was real. It would constitute a

[31] Barbour, Julian, *The End of Time*, (1999) Oxford University Press. Mentions Einstein's critique of Newtonian time along with his own weird statements that the passage of time is an illusion.

proof of the incompleteness of the SH. This points of course to our particular interest in incompleteness proofs.

Poincaré Incompleteness and the Heraclitean Discontinuum

Henri Poincaré formally proved that even the simple Three-Body Problem of the Cartesian-Newtonian system was unsolvable. The consequence was that the answers to clearly meaningful questions in the Newtonian system were undecidable. Poincaré was convinced that one of the implications of Three Body Problem was the incompleteness of Euclidean geometry. If this is indeed the case one might well rename the Three Body Problem, the Three Body Paradox – parallel to what I have referred to as the Pythagorean Paradox.

Poincaré's problem was not just any sort of problem. It was not just a problem *within* the system. It had been demonstrated to be a problem *for* the system. It was a problem that – by its very nature – could never be solved within the Scientific Research Program. It was a proof of the incompleteness of Newtonian mechanics – with apparent implications all the way up to Euclidean geometry and the Parmenidean metaphysics.

Poincaré discovered a chaotic deterministic system and laid the foundations of modern Chaos Theory. Poincaré's work points to an objective, deterministic, Heraclitean Discontinuum. Poincaré pointed out that the time evolution of a system such as the solar system is chaotic in the sense that a small perturbation in the initial state, such as a slight change in one body's initial position, might lead to a radically different later state.

Poincaré's conclusion, reasoning from the Three-Body Problem that Euclidean geometry was formally incomplete lead him to develop one of the early version of Relativity. Lobachevsky and Riemann developed the complementary Non-Euclidean geometry from the historical root of concern about Euclid's parallels axiom. Both these were mathematically preliminary to Einstein Special and General Relativity. Whether the real universe is Euclidean or Non-Euclidean should be undecidable.

Carnot and Maxwell

A separate challenge to the Mechanical Philosophy came from the classical theory of thermodynamics. The Second Law of Thermodynamics indicated that the behavior of real phenomena was not symmetric in space-time in the classical mechanical sense. The universe as a whole seemed to have a net direction in time – by its very nature.

Mendelssohn[32] captures the step at which probability is introduced as an objective characteristic of the thermodynamic phenomena:

"Maxwell and Boltzmann [found the relation between Boyle's pv=RT and Newton's laws and] expressed pressure and temperature in terms of the average energy of motion of the

[32] Mendelssohn, K. "Probability Enters Physics", in *Turning Points in Physics* (1959), Harper & Brothers, NY, page 46-47.

gas molecules. Please, note that I have just introduced the term "average" which, as far as the individual molecule is concerned, expresses a probability and not a certainty. "Average" and "probability" are statistical concepts which did not occur in either Newton's or Boyle's reasoning."

The role of chance in the relation between the Newtonian mechanics and Maxwellian thermodynamic systems is clearly stated here supporting the general line of reasoning in this essay. Stated at the metaphysical level the Heraclitean universe (Maxwellian) is a sort of statistical complement, by a sort of *via negativa* reasoning, of the Parmenidean universe (Newtonian).

In the modern physics community Boltzmann is typically represented as winning the debate with Carnot, reinterpreting Boyle's non-atomistic phenomena to the collective, ensemble, atoms behaving according to Newtonian physics. The dominant, politically correct position in modern science is that the ensemble view is entirely commensurable with the individual view. And depending on whom you are talking to the atomistic is derivable from the statistical or vice versa.[33]

Maxwell, himself was adamant in emphasizing that these were not derivable one from the other but represented two distinct ways of looking at 'reality'. In this sense Maxwell is positing an early version of the particle-wave complementarity at the heart of the Copenhagen Interpretation of Quantum Physics.

Quantum Theory

The important lessons I wish to draw from the development of quantum theory can be put in terms of (a) the differences in the nature of classical and quantum phenomena and (b) the corresponding differences in the nature of the laws governing those different types of phenomena.

Quantum theory began to emerge as a result of failures in trying to understand micro-level phenomena in terms of established macro-level concepts. In Bohr's model the atom, with electrons orbiting the nucleus, naturally radiated, leading to 'absurd' results.[34] In the new model Bohr just assumed – the exact opposite – that atoms are non-radiating in their stationary state. As de Broglie points out:

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[33] These derivations are not valid either way.

[34] de Broglie, Louis, *The Revolution in Physics*, (1958) The Noonday Press. "If then the electromagnetic theory in the form given it by Lorentz were actually applicable to the elementary particles of electricity, it would allow us to calculate without any ambiguity the radiations emitted by an atom of the Rutherford-Bohr planetary model. We have already seen to what grossly inexact predictions we would be led. If an atom constantly lost its energy in the form of radiation, its electrons would all end by falling very rapidly into the nucleus, and the frequency of the radiation emitted would constantly vary in a continuous fashion. The atom would be unstable and there could not exist spectral lines of well-defined frequencies – which are absurd conclusions." Page 146

"To avoid this essential [absurd] difficulty, Bohr, as we have seen, had supposed that the atom in its stationary states does not radiate; this is tantamount to denying the possibility of applying the electromagnetic theory of radiation to the orbital motion of the electrons in their stable trajectories."[35]

The essential point to understand and emphasize here is how different the descriptions of the phenomenon of emission are from the point of view of classical and quantum theory.

"In the classical theory, an atomic electron in motion radiates, in a continuous fashion, a whole series of radiations: the emissions of these radiations is therefore both continuous and simultaneous. In the quantum theory, on the contrary, an atomic electron does not radiate when it is in a stationary state, and when it jumps from one state to another . . . the emission of the spectral lines of an element is discontinuous and proceeds by isolated individual actions. Surely then it is difficult to find two conceptions more different from each other than the classical conception and that of the quantum theory and at the very first it can legitimately be asked if any bridge can be built to connect them."[36]

Bohr's strategy required the introduction of a probabilistic relation between the two frameworks:

"When we reflect on the means of establishing a correspondence between the classical picture of emission of the spectral lines and the so dissimilar picture that the quantum conceptions suggest to us, we at once perceive that this correspondence, if it ever is realized, can only be of a statistical nature."[37]

De Broglie recalls (paraphrasing), 'as we were attempting to determine the classical laws governing the behavior of all physical phenomena, we were forced to the conclusion that there were phenomena which – *by their very nature* – are governed by chance'. To many researchers at the time this meant that the pursuit of universal, same cause-same effect-type laws – as suggested by the Scientific Hypothesis – must be inherently incomplete. There were unavoidable, irreducible phenomena that simply could not be understood in these terms. De Broglie continues, 'then we entered terra incognita as we realized that there was order in the chance'.

This created the curious situation where there were two types of laws: the regular law-laws, where the same cause always produced the same effect, and the new chance-laws, that allowed one to predict, but only in a statistical sense. This is rather like stating an oxymoron: that we have two objective orders. It is oxymoronic in that to say that there is an 'objective order' means that that it is the universal order governing all phenomena – from all possible points of view, from any frame of reference, complete and consistent. You can't sensibly – self-consistently – have two of these. We have a paradox – looking rather like a Dialectical Dilemma. According to Poincaré:

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[35] De Broglie, Louis, The Revolution in Physics, (1958) The Noonday Press. page 146
[36] Ibid page 147
[37] Ibid page 148

"Our first glance at the distribution of the [spectral] lines makes us think of the harmonics that are met with in acoustics, but the difference is great; not only are the wave numbers not successive multiples of the same number, but we do not find anything analogous to the roots of those transcendental equations to which we are so often led in physical mathematics. . . . the laws are simpler, but they are of an entirely different nature . . . Of that, we have not taken account, and I believe that there is one of the most important secrets of nature."[38]

With the priority – for this group of physicists – on understanding the behavior of phenomena at the atomic level, it became necessary to make a choice between the classical and quantum framework as to which *type of law or order* was more fundamental – which type allowed one to perceive 'reality'.

"It was therefore necessary to classify henceforth Newton's mechanics and even that of Einstein as being the "old mechanics" and to create a new mechanics in whose framework the old mechanics will appear as first approximations, valid under certain conditions."[39]

The new type of laws not only introduce chance and probability as essential components, they seem to make them the foundation.

"Everywhere the certainty of the old mechanics gives way to probability. We are glimpsing here an important change in the method employed by science in the representation and prediction of phenomena, a change which embraces important philosophical consequences."[40]

This conversion to a new type of chance-law at the foundation of science understandably lead many scientist to suggest that this was no longer science – consistent with the Scientific Hypothesis. De Broglie continues:

"There has been a great deal of discussion in the last years about this question of indeterminism in the new mechanics. A certain number of physicists still manifest the greatest repugnance to consider as final the abandonment of a rigorous determinism, as present day quantum physics must do. They have gone to the length of saying that a non-deterministic science is inconceivable." [41]

Place of Chance in the Modern Worldview

The introduction of chance as a real, objective characteristic into the modern worldview alters the conception of reality considerably. Chance is no longer subjective – a mere appearance or an illusion. Acceptance of chance as a real component of reality is to

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[38] Poincaré, H., *The Value of Science,* p. 305
[39] de Broglie, Ibid, page 167
[40] Ibid page 180
[41] Ibid page 216

accept the incompleteness of the original Scientific Hypothesis. This is not an uncommon opinion, but its implications are difficult to understand.

Reality seems to 'participate' in both types of phenomena – each associated with either the Parmenidean or Heraclitean metaphysical frameworks.

Quantum theory appears to be an encounter with the paradoxical Dialectical Dilemma. The Copenhagen Interpretation argues that each potential observer is faced with a choice – or range or field of choices – of how to observe the world. This reintroduces the observer back into the picture of reality. The subjective component, excluded by earlier objective, deterministic models, must now be understood as an irreducible aspect of the nature of reality.

In the Copenhagen Interpretation just how to incorporate the observer in a self-referentially consistent way is presented not as a specific answer, but as the challenge.

Maxwell's Spectrum

The aim of this section is to present a thought experiment and by analogy to provide the reader with an image of what a possible solution to the Dialectical Dilemma might look like. This I believe will serve as a guide in following the next stage of developing the resolution wherein the two metaphysical systems – Continuum and Discontinuum – and their respective research programs become special, or limiting, cases within a more general, Third, Middle Way, metaphysics.

James Clerk Maxwell, in his book, *Matter and Motion*, explores causality:

"There is another maxim . . . which asserts "That like causes produce like effects." This is only true when small variations in the initial circumstances produce only small variations in the final state of the system."[42]

Sir Joseph Larmor comments in a footnote to this passage: *"This implies that it is only in so far as stability subsists that principles of natural law can be formulated: it thus perhaps puts a limitation on any postulate of universal physical determinacy such as Laplace was credited with."*[43]

Maxwell continues:
"In a great many physical phenomena this condition is satisfied; but there are other cases in which a small initial variation may produce a very great change in the final state of the system."[44]

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[42] Maxwell, James Clerk, *Matter and Motion (Notes and Appendices by Sir Joseph Larmor*), (1991 Dover edition), page 13
[43] Ibid, page 13
[44] Ibid page 13-14

Larmor comments: *"We may perhaps say that the observable regularities of nature belong to statistical molecular phenomena which have settled down into a permanent stable condition. In so far as the weather may be due to an unlimited assemblage of local instabilities, it may not be amenable to a finite scheme of law at all."*[45]

Imagine a line. At one end is the relation of natural law: same cause, same effect. At the other end of the line is what we might begin to describe as turbulence.

Natural Law Turbulence
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Anyone familiar with the modern discussion of Chaos Theory will recognize in Maxwell's first statement – "*when small variations in the initial circumstances produce only small variations in the final state of the system"* – the nearly identical phraseology used to describe what came to be called the "butterfly effect". Chaotic systems are characterized in precisely these terms.

What Maxwell is saying is that the classic Newtonian image of a world where all phenomena are related by natural law – the same cause always and everywhere necessarily producing the same effect – is not universally characteristic of the real world. In other words, the Scientific Hypothesis that all phenomena are governed by a universal (i.e. time-space invariant) order doesn't reflect reality.

Take one step away from the left hand, natural law extreme. Consider a coin flip. Here, slight differences in the cause produce two equally probable two effects. With very slightly different throws of a six-sided die, there are six possible effects of the same cause. Consider slightly different throws of a die with an increasing number of sides. As you reach the number if sides equal to the possible states of the system you have the complete opposite of same cause, same effect. With a large number of such units you approach a perfect turbulence.

In the classical Laplacean image of *"universal physical determinacy"*, as Larmor points out, the chance aspect was taken to be an illusion.

On the extreme right hand side, there is a complete spread of possible outcomes from a given original causal state of affairs. Any effect is equally probable from a given cause. This causal condition applied to the situation of an ideal gas contained in a box is equivalent to the statistical description of thermal equilibrium.

Consider next that the two polar-extreme images are idealizations: on the left side, a perfect same cause, same effect natural law relation, and on the right side, the purely statistical image.

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[45] Ibid page 14

If we eliminate the extremes we are eliminating the possibility of an objective instantiation of either 'pure' type of phenomena. Between the idealized extremes is a universe of phenomena that 'participate' – by their very nature – in both types. Asking about the correct description of the universe, by eliminating the extremes, we are eliminating the possibility of an objective universe of either the Parmenidean or Heraclitean type.

The greatest limitation of this analogy is that the two ends of the spectrum are really irreconcilably different. And that is not obvious since I developed the sense of the right side by an incremental *via negativa* line of reasoning from the left. This just tells us that the right side idealization is what the left side is not. But the right side ideal should not have any quantitative aspect at all. The right side – in its own terms – is perhaps better characterized as purely qualitative; pure discontinuity (viz. even in the sense of an infinity, open and continually changing). Following this speculation with a reverse *via negativa* characterization starting from the right, we would want to say that – starting from pure heterogeneity (viz. pure quality) – the line becomes increasingly homogeneous until we reach the left hand extreme where there would be pure homogeneity – plausibly the purely quantitative, mathematical (viz. pure quantity).

What this image is conveying is a transition from thinking about the Parmenidean and Heraclitean metaphysics as opposing 'positions' – where one might imagine that each could be separately axiomatized, to an image of polarity. The idealized endpoints are 'inconceivable' – self-referentially inconsistent. The attempt to define a universe in terms of either extreme ideal leads to absurd and self-contradictory conclusions. The important consequence of the polar model is that the two complementary approaches to understanding the universe now become special, limiting cases within a more general picture. Each of the two metaphysics capture something more like a way or line of reasoning – move to the right; move to the left – pointing in polar opposite, balancing directions. To actually arrive at one of the poles is to arrive at paradox. All real phenomena are in between, in what I am inclined to refer to as the Middle Ground.

The implication I take from Maxwell's comment is that our knowledge of natural law phenomena and natural law relations is selective – genuinely discovered – out of the real, more complex and sophisticated universe. Natural law relationships are special limiting cases within a more general metaphysics. The image fits both the universe and each individual phenomenon. Natural law phenomena are not universal.

This is a representation that is greatly superior to what David Hume pinned on science. No one seemed able to respond to Hume's characterization of science as a compilation of simple correlations. These were not discovered through investigation but simply observed and recorded – with no real justification for the inductive generalization. That there might be some difficulty or problem in discovering the cause of some effect simply doesn't arise. But in Maxwell's implicit model natural law phenomena and relations are only part of the picture – and plausibly 'hidden'.

In Maxwell's model laboratories, experimentation and intelligent, problem-solving investigation immediately begin to make sense. The reasoning however remains as ambiguous – as hidden – as the definitions of the phenomena.

Another feature of the Maxwell's Spectrum image is that there is a marriage of causal dependence and causal independence that makes a lot of sense. This is how we normally tend to look at the world. The normal description of the tools of scientific method always speaks of the manipulation of independent variables. At the left hand extreme it is a world of exclusively dependent variables. And at the right extreme it is a world of independent variables. There is complete and consistent causal dependence on the left (Continuum), balanced by the complementary complete and consistent causal independence on the right (Discontinuum).[46]

Take one more step with Maxwell's Spectrum. Move from the original image of a line with two poles, to a new image where each ideal type defines the axis of a simple two-dimensional graph. This defines a space. The space is 'dappled' with natural law relationships. All that is excluded from the space is the axes themselves, no Middle Ground phenomena touches either axes. Each natural law relationship is limited, conditional – non-universal. Non-universal means non-objective. If non-objective then there is some suggestion of a role for the subjective. And yet in a sense each type is the discontinuity of type of the other; each is the subjective for the other. Confusing.

The image of a world composed of some sort of mix of causally dependent and causally independent relations is appealing. In the Parmenidean system all relations are causally dependent. In the Heraclitean system all relations are causally independent. Both the Parmenidean and Heraclitean metaphysics – each taken alone as universal – are deterministic. In a mixed system manipulation seems reasonable. I particularly like the further implication that the test of a scientific discovery is 'participant demonstration' rather than 'detached prediction'. This is the difference between a Middle Ground universe where the investigator is a participant, and either of the extremes where the investigator is an 'unreal, subjective' detached observer.[47]

The knower in Hume's model is a passive, detached observer. In the Middle Ground model the knower should be able to tell you just as easily how to prevent (viz. by manipulating independent variables) as to predict an event. His knowledge is obviously more substantial than that of a passive, detached observer. But just what he knows is still unclear.

Part Three – The Third Metaphysics
Summary and Final Strategy

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[46] Except here the systematic approach is not always or even expectedly likely to succeed; because these are not simply linear relations and a commensurable complement.

[47] This points to the dialogue between Pragmatism and Positivism. Can we test the difference?

The basic thesis of this essay is that the science-religion dialogue is better conceived in terms of a three-part metaphysics context rather than the more common two part.

In the two-part representation the science and religion are pitted against one another. Because there are apparently irreconcilable differences between traditional scientific and the traditional religious view of the universe, a problem with one tends to be viewed as potential support for the other. And arguments that one or the other has serious problems or is deeply flawed, encourages support for the other. None of the demonstrated, or reasoned, problems or flaws of either the scientific or religious views have established a decisive conclusion. As pointed out, the problem of reaching a commonly agreed resolution is compounded by the fact that each views any possible solution in different terms. This back and forth continues unresolved.

The arguments I have developed up to this point are really just establishing the possibility and perhaps a rough plausibility for the three-part metaphysical treatment. The three-part strategy maintains that the proper opposite of the metaphysical framework associated with a rigorously axiomatized scientific view is a complementary, axiomatized historical and cosmographical view. In the ancient dialogue on these issues the two opposites are associated with Parmenides and Heraclitus.

The ancients, I have argued, were convinced of the mutual incompleteness of these two metaphysical perspectives. Incompleteness proofs are a central component of the line of argument in this essay. The Pythagorean Paradox illustrated the argument for the incompleteness of at least the Pythagorean version of the Parmenidean metaphysical view. The incompleteness proofs are an inseparable part of the three-part metaphysical solution being proposed. The incompleteness means incorrectness of the universal extrapolation of the perspective. It does not mean universal, or 'objective', falsity. The incompleteness of the competing metaphysics leaves open the possibility that, although irreconcilable in each other's idealized terms, they might both be understood as special, limiting cases within a more general metaphysics.

I suggested that Plato, at least, embraced the paradoxical undecidability of the question as to which one is more fundamental in describing reality. This embrace of the paradoxical undecidability lays the ground for defining a new view. But at first the embrace is rather disconcerting, and this initial step lands one in what I have referred to as the Dialectical Dilemma. I briefly explored the Socratic position as a novel response to the Dialectical Dilemma. I argued that in the Socratic context the prior two metaphysics are not rejected but accepted and included as special, limiting cases within the new, more general metaphysical framework.

I argued briefly that the Socratic context could be usefully characterized in terms of the question, 'How should we live?' This question did not make sense – was not a meaningful question – in either of the other two metaphysics in that they are both deterministic. I suggested that the question 'How should we live?' is the core question that defines the problem of design. I suggested that the problem of design is, in broad outline, also the defining problem of engineering. Stated in pragmatic terms the problem

of design is ‘how to bring new good things into the world.’ But when Socrates, who has dismantled all proposals, is asked for the correct design agenda he says that he doesn’t know. The Socratic context is inherently problematic. The Socratic character is ‘blind’ and can only learn about ‘good’ or ‘better’ designs for life, for the universe, by actively investigating the potential design space. In order to investigate the design space one must actively implement different designs and different design strategies. As in normal, common sense engineering, there is an irreducible element of blind trial and error. As we succeed we learn to ask better and better questions. The Socratic character is modern parlance is a sort of existential pragmatist, or pragmatic existentialist.

In my review and treatment of the modern era, I argued for a rough parallel between the ancient and modern dialogues.

I argued that the Newtonian and Relativistic frameworks are, as both Bohr and Kuhn have similarly suggested, likely to turn out to be complementary. The argument that the success of Newtonian physics is correctly understood in terms of its being a limiting case within the more general, ‘objectively’ valid Relativistic space-time, simply doesn’t carry. In both logical and mathematical terms it looks more like a subsumption – a play in the Appearance-Reality Game. A more plausible suggestion is that all real – Middle Ground – phenomena ‘participate’ in, and require for their full description, both space-time frameworks; both metaphysical perspectives. Confronting this dualism is an encounter with the Dialectical Dilemma.

I went on to argue that the development of quantum theory can similarly be understood in terms of a standoff between classical (macro) physics and a new (micro) physics that is built on a probabilistic logico-mathematics. I argued that the probabilistic framework should be understood as the re-emergence of the deterministic Heraclitean complement to the classical determinism. I criticized the Correspondence Principle arguments wherein the ‘old metaphysics’ of Newton and Einstein are viewed as special, limiting cases within the more fundamental, probabilistically based quantum physics. The arguments of the reigning quantum physicists that the success of the classical, macro-physics can be explained or understood by viewing the macro-physics as a special, limiting case (viz. when the quantum numbers are large) of the micro, quantum physics are invalid. Again, the quantum physicist’s arguments look more like a play in the Appearance-Reality Game.

I pointed out that the development of thermodynamics also fits the model of two competing metaphysical representations. Maxwell warns us explicitly that these two ways of representing phenomena – these two ways of observing – are essentially different; one cannot be legitimately derived from or arrived at from the other.

The two traditions represented by Boltzmann and Carnot are still used in research and application. Yi has argued that the reduction of the classical (Carnot) approach to the

statistical (Boltzmann) approach is problematic.[48] I agree with Yi that it is more plausible that these two approaches – also corresponding to the opposing statistical-micro and classical-macro views of the substratum – "are competitive and compatible" – in both the micro and macro settings.

The Dialectical Dilemma

What I have referred to as the Dialectical Dilemma is a paradoxical situation. It is not simply that the two conceivable alternative ways – call them A and B – of understanding or explaining the order governing of the universe turn out to be inherently incomplete.

The larger, compounding difficulty is that these two alternatives are not simply views – but they incorporate or embody views about views. They have a sort of built-in self-referential aspect. They both claim to be universally true, objective, the complete and consistent account of the behavior of all the phenomena in the universe.

In both A and B, the order of the universe and the method for understanding the universe are inseparable. The *logos* as the rational order of the universe, and the *logos* as rational method of making sense of that universe, are, and indeed must be, the same. This seems straightforward. By analogy, if what you are trying to make sense of is written or spoke in Japanese, then to make sense of it, to observe or listen to it coherently, you need to observe and listen in Japanese. You wouldn't expect to be able to understand what Galileo called the language of nature in any other way than by using mathematics. For Galileo, the Pythagoreans and the Parmenidean metaphysics in general, this was the path to the final Theory of Everything. Answers to questions of fact are either true or false – objective; for everyone, everywhere for all time. Ambiguity is an illusion, not a coherent experience of reality.

The B view postulates a different type of phenomena and a different type of order governing those different types of phenomena. The type of phenomena and the rational type of order, the *logos,* of the B view, are so different as to be irreconcilable with the A-type phenomena and the A-type order. The B view posits that the language of nature is a language that is very different from the A language; so different that there is no possible translation. They are incommensurable. The B language – in its own terms – is a sort of narrative. Like any history, it is story-like; perhaps like a script. The questions within the B research program are imagined to be no less 'objective' than in the A research program. The story of the universe is the story of the universe. There is similarly, in this reality, no ambiguity as to the plot and how it develops. All misunderstandings are subjective. The script is the script.

Both views share a commitment to objectivity – the truth is the truth. They both endorse either/or logic. They are both committed to telling us, or discovering the way the world is – in fact. Our difficulty is that there are two 'is-es'. Each makes sense of a type

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[48] Yi, Sang Wook, "Reduction of Thermodynamics: A Few Problems", Philosophy of Science, 70 (December 2003) pp.1028-1038.

of phenomena. The incompleteness arguments force us to accept that there is something of each in the other. It is undoubtedly this characteristic that led Bohr in 1947 to select the tai-chi mandala, the yin-yang symbol, for his coat of arms. [49]

The objectivity of the Heraclitean metaphysics is difficult to interpret. It speaks in contraries and contradictions. But maintains this consistently. Paradoxically the troublesome belief is in anything being in agreement – by its very nature. In other words the only irrational beliefs are those of the Parmenideans.

Proponents of each system appear irrational to the other and yet they don't actually clash, but rather talk past each other, speaking in irreconcilably different languages. This is really just the idealized, stereotyped image of the 'true believer' in each system trying to reason with complete consistency. All real conversation is in the Middle Ground.

Just as each posits a different type of world each posits a different method for understanding it.

The Transition to the Third Metaphysics

The Dialectical Dilemma in the modern context is well captured by the images associated with the Copenhagen Interpretation of Quantum Physics. The particle-wave complementarity represents the two 'objective', yet irreconcilable, *types* of phenomena, along with the two 'objective', yet irreconcilable, *types* of laws governing them.

The quantum measurement problem arises as a challenge of how to make sense of the reality of the subjective. The observer faces a range of options as to how to observe. His choice determines the actuality of real experience selected from the field of possibilities. Making sense of this relation is central to the theme of this essay.

One metaphysical reflection is that in order to recognize the mutual incompleteness of the Parmenidean and Heraclitean metaphysics we must be in a position that cannot be reduced to or accounted for in terms of either of these metaphysics alone. Where are we standing in order to be able to see the Dialectical Dilemma? If we are the inquirer, then this situation – this standing – tells us something about ourselves and about our inquiry.

Extending this approach to understanding the 'actual subjective' one may reflect on the research or learning enterprise itself. Just what is it that we are doing? Initially as supporters of the Scientific Research Program we imagined that we were discovering the universal time-space invariant laws governing all phenomena in the universe. However,

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[49] "Contraries are complementary" The traditional Chinese taiji symbol became a scientific *icon* when Niels Bohr made it his coat-of-arms in 1947 (with the motto: *contraria sunt complementa*) but the symbol was never meant to convey any precise scientific meaning...

now we have concluded that there are no such laws, and indeed, the very concept of such laws is inherently incomplete, and self-referentially paradoxical.

So whatever it is that we have been doing, we have not been discovering these laws. This again brings forth the idea that we might have been doing something other than, something more sophisticated than, what we thought we were doing. In other words we can't account for what we have been doing in terms of the model provided by the Scientific Hypothesis and/or its Scientific Research Program. Nicholas Maxwell has developed this theme, suggesting that scientists are formally neurotic (viz. doing other than what the say they are doing).[50] Thomas Kuhn's famous book, *The Structure of Scientific Revolutions*, argues similarly, that the actual practice of inquiry does not correspond to what is expected based on the Scientific Hypothesis (viz. roughly corresponding to the Positivist history and philosophy of science).

Imre Lakatos, noting that scientists don't reflect on their activities and don't read those who do (viz. in the philosophy of science), offered the following image: scientists don't need a theory of science in order to do science any more than fish need a theory of hydrodynamics in order to swim.[51] This now should be broadened: inquirers (or even children) don't need a theory of how to ask questions in order to ask questions any more than fish need a theory of hydrodynamics in order to swim. The point being that what we are doing is one thing and how we represent what we are doing to others and even to ourselves may be another. Our theory of science is a theory about ourselves as well – about our actions, about how we accomplished what we accomplished. However, our theory of what we were doing, based on the SH and SRP, turned out to be inadequate to account for what we have demonstrably done in the history of human inquiry and enterprise.

The inadequacy of the scientific worldview associated with the Scientific Hypothesis can be seen in the fact that it doesn't make sense of the enterprise itself. Consider the following. If all the phenomena of the universe – including us – are governed by objective, time-space invariant, deterministic laws, then there is no point in discovering those laws. There is no point or purpose or possible benefit because what will happen will happen. Discovery of the laws does not entail any empowerment to change the course of events. Some defenders of the SH model suggest that at least we would be able to predict what was going to happen anyway. But this follows if and only if the laws determine us to make the right predictions. There is no point in learning the laws that already govern our actions. Nothing is added or achieved.

The scientific worldview associated with the Scientific Hypothesis is unable to provide any account of learning. If we are already governed by the laws then no practical sense can be made of learning them. There is an implicit separation (viz. ignorance) of the inquirer and his object of inquiry that is unaccounted for in the scientific model. Basically the scientific model of the enterprise of science makes no sense; is

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[50] Maxwell, Nicholas, *What's Wrong with Science?*(1976) Bran's Head Books

[51] Lectures at London School of Economics, University of London, 1969-1970

unintelligible. Another way to say this is that the scientific account of the scientific enterprise is not self-referentially consistent.

This suggests a positive theme: that if there is a resolution of the metaphysical paradoxes, it should be – by its very nature – self-referentially consistent. In other words, we anticipate that the Third metaphysics should propose an account of the universe and our activity in it that is self-referentially consistent.

The Embrace: The Third Metaphysics

Characterizing the Third Metaphysics begins with the embrace of the Dialectical Dilemma. This step was previewed in my account of the Socratic embrace of the metaphysical standoff of the Parmenidean and Heraclitean systems developed in Plato's dialogue, *Parmenides*.

The embrace defines a new problem context, indeed, a new *type* of problem context. What was paradoxical prior to the embrace now makes sense in a new way. Just as with the Socratic context the 'real subjective' position is inherently *problematic*. If it constitutes an 'answer' to what was bothering us in considering the Dialectical Dilemma it is an answer of a different *type*. I like the simple image arising from the notion that 'the secret is that there is no secret'. In other words, the answer to the question as to what universal order governs the behavior of phenomena (viz. the secret), points first to the notion that there is no such order. But more profoundly, says, 'undecidable' between the 'universal order' and 'universal disorder'.

This answer – embracing the undecidability – defines a new problem context, a new way of understanding ourselves, the universe and our place in the universe, as well as raising a new type of question as to how we should proceed.

For Socrates, the new problem context is captured and characterized by the core question: How should we live? In a deterministic system – any deterministic system – this is not 'really' a meaningful question. An even more general implication is that in deterministic systems there are no 'real' problems of any kind. This suggests a direct connection between indeterminism implicit in the embrace and the reality of problems.

Another way to characterize the new problem context is in terms of the relation between facts and values, or between 'is-type questions' and 'ought-type question'. The undecidability of the question of our two 'is-es' – Parmenidean and Heraclitean – defines an 'ought' or 'ought-like' context. The new context isn't an ought context in the sense that it tells us what to do. Rather the 'ought' here is naturally – by its very nature – problematic. The new context identifies and defines a new problem.

Reasoning from the Copenhagen Interpretation, our new problem is how to choose how to observe. We have options. We face a potential field that does not determine our choice. And we, having the *potentia*l to observe/act, are similarly indeterminate. Should we look at the universe in terms of a 'particle-metaphysics' or in terms of a 'wave-metaphysics'?

The 'real subjective' (viz. the observer/actor) here is existential. He has potential to act, but no *apriori* reason to select one way rather than another. Nothing in his nature determines him to choose one way or the other. To say that the 'real subjective' is existential is to say that it is not 'essential' (viz. no *apriori* nature that determines choices). This means that the 'real subjective' – by its very nature – is not determined to choose one way or the other from its potential options. This is consistent with the fact that neither of the two deterministic metaphysics is adequate to account for the behavior of the observer/actor.[52]

A simple formulation of the 'is'-to-'problematic ought' transition is to say that the answer is a question. As we seek the answer to the way the universe works – the answer to the 'is' question – we are forced into a new context that identifies a new question. The new question is defined by the inherent incompleteness of, and undecidability between, the deterministic options. How the universe works is not objective – it requires an irreducible subjective component. What we are trying to clarify now is the nature and position of that 'real subjective' component or aspect. The beginning here is to recognize that the context of the 'real subjective' is inherently problematic.

Consistent with the characterization of the Socratic context, there is no right answer to 'the problematic ought'. The subjective context is well captured by the Socratic question: How should we live? When asked to predict whether there will be a sea-battle tomorrow, our answer might reasonably be that it hasn't been decided yet. The future is open – but not totally open and certainly not objectively (viz. universally, completely and consistently) open. The 'real subjective' aspect is existential and yet constrained by pragmatic reality.

Reflecting on the situation one can say that the potential observer/actor not only needs to decide, but he needs to decide how to decide. But since the observer/actor is incarnate from the beginning – by virtue of being a potential observer/actor – one can say that he chooses of necessity. This is a common theme of existentialist thinking: that to suspend choice is just as much a choice as any other. To be is to do. To be an incarnate potential observer/actor is necessarily a continuous choosing (viz. how to live). This alters somewhat our characterization of the context of the 'real subjective'. The potential and the actual are inseparable. To have potential to observe/act in one way or another entails that you are already observing/acting in some way. On the other hand, being actual means that you, as a potential observer/actor, have real potential to observe/act in other ways – moment to moment – by your very nature, or by the very nature of the situation that includes you.

The recognition of the inseparability of the actual and potential aspects of the 'real subjective' clarifies the nature of the new 'problematic ought' context. The 'real subjective' – every individual in the Socratic conception of the world – because they are

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[52] If either of the deterministic metaphysics (or their sum) were adequate then the problem – the Dialectical Dilemma – would never have arisen in the first place.

actual, has a 'working hypothesis' as to how he should live. In virtue of being incarnate potential in the world you must also be actualizing. To be is to do.

There is always the possibility of self-destructive choices. The 'real subjective' can self-destruct or indeed be destroyed by other contingencies. The 'real subjective' – the observer/actor – finds himself in a pragmatic context. The 'real subjective' is, therefore, by this line of reasoning, an existential pragmatist. Or alternatively we can call him a pragmatic existentialist.

The potential of the 'real subjective' can be thought of as analogous to money. If one wins a million dollars in the lottery, the million dollars doesn't tell you how to spend it. The million dollars is potential. The potential aspect of the incarnate, potential observer/actor doesn't self-determine how it is to be actualized. But once you have the money – the potential – you must do something with it, even if, in some sense, you decide not to spend it.

This analogy with money allows us to point at another aspect of the notions of actual and potential for the 'real subjective'. The potential is not simply a property of the 'real subjective'. It is a property of the system. The money has different value, different potential, depending on whom has it and the nature of their pragmatic context. The pragmatic context can be thought of a composed of the local capacities and constrains of the individual 'real subjective' and his surroundings.

In making the transition from the Dialectical Dilemma to the Third metaphysics, we are making a problem-shift. In the Dialectical Dilemma we encounter the incompleteness and paradoxical undecidability of the 'is' problem. The embrace of the mutual incompleteness of the two deterministic metaphysical options identifies and defines the new problem context – the 'problematic ought'.

Immanuel Kant makes a similar transition from the rejection of the decidability of the objective 'is' in his *Critique of Pure Reason*, to the exploration of the pragmatic context in his *Critique of Practical Reason* to a final recognition of the existential status of the 'real subjective' in his *Critique of Judgment*. The 'real subjective' experiences what Aristotle so aptly expressed as the 'agony of deliberation' – trying to make intelligent judgments.

The Engineering Perspective

The existential pragmatist is faced with the Socratic question: How should we live? I have already suggested that the Socratic question is the core defining problem of engineering: the problem of design. The engineer is an actor, but equally an inquirer.

How should we design the irrigation of our fields? How should we design our houses, our neighborhoods, and our cities? How should we design our economic and political systems? How should we design our common and individual governance? How should we treat each other? The design context is the moral context. The design context is the real religious context.

The existential pragmatist, the participant 'real subjective' is the engineer. This is not a final answer but a new step toward clarification.

The engineer learns but does so blindly. He is an existential actor and learner. The engineer embodies blind agency. Agency does not make sense in deterministic systems, but re-emerges here in the Third metaphysics.

Developing the engineering perspective is not simple or straightforward. The scientist must be a special, limiting case aspect of the engineer. The engineer can learn but what he learns cannot be accounted for in terms of the scientific conception of his problem. The engineering context is broader. The engineer learns about the world – discovering natural law relationships – but these simply increase his potential. His learning cannot be represented as a convergence to the natural law idealization of the Scientific Hypothesis. As the engineer learns natural law relations he increases his separation – increases his existential ignorance in the sense of the new problem context. In other words, as he learns how the world works he increases his potential – his field of potential actions. In a positive sense he learns how to ask better and better questions.

The engineer is a problem-solver. But he doesn't know what problems to solve. Problems are not 'objective' in the deterministic sense. Curiously problems are inherently problematic. The engineer is always constrained. But he seems to work towards a lessening of those constraints – and thereby to increase his existential potential. His value seems to be to increase potential. This is analogous to increase his wealth – money in the bank. The engineer is a wealth creator. Equivalently it can be viewed as increasing his freedom; his freewill.

In the evolutionary context he is not interested in adapting to nature as much as in constructively developing it – and thereby increasing his potential field, both quantitatively and qualitatively. If the problem of design defines engineering, then the scientist's idealized problem of discovery becomes, in this new context, discovering truths that build the engineers potential. In the sense of the American Pragmatists, what he discovers must – by its very nature – have 'cash value'.

The engineering context however is inherently problematic as Socrates stresses. When asked how to design the ideal political system, or even less ambitiously, a better one, Socrates says he doesn't know. If we ask a modern scholar of political science or political theory how to build a better political system, he may have some ideas, but basically he doesn't know. If we ask an engineer of the 12th century to design a flying machine – an airplane – how will be proceed? Blindly. But the blindness isn't total – objective, complete and consistent. The engineer always has a starting point.

The research component of the engineer's problem-solving agenda is a natural and necessary component. Since the world is not 'objectively' uniform, every act occurs in what is at least a slightly different situation. Every act then is an experiment, an

inquiry as to whether what I have learned so far, in terms of skills and value-creation, is going to work here and now.

The engineer then so far is an agent that has some irreducible blindness, inherent in his potential, but also inherent in his potential is a constrained capacity to operate in the world, to change the course of events.

Royce's Reflexive

The American Pragmatist, Josiah Royce provides another path to the new problem context of the Third metaphysics.[53]

Royce notes that our 'working hypothesis' is that we are engaged in this natural inquiry trying to understand how the universe works. There are implications of that working hypothesis. Learning must be possible. And the universe must be understandable. Furthermore, since we are a natural, 'real subjective', part of the universe then there must be something in the very nature of the universe that has to do with individual inquirers learning about the nature of the universe.

This 'working hypothesis' as well as these entailments doesn't sensibly arise if you begin with a deterministic model of the universe. Learning, in any relevant meaningful sense, does not make sense in a deterministic model. The Socratic question is not real and meaningful in a deterministic universe. Problems are not real and meaningful in a deterministic universe.

Royce points out that in order to be self-referentially consistent, whatever model of the universe one proposes as the correct model, must include someone – like the proposer – who could have figured it out; could have learned it. This has a couple of powerful entailments. First, the universe must be such that one can learn how it works. Second, the universe must contain learners.

Royce's arguments here provide us with an important criterion for evaluating proposed models of the universe. Such models must be, quite generally, self-referentially consistent. I have argued that all deterministic models are self-referentially inconsistent. Royce focuses on learning. Making sense of learning has some obvious basic entailments: a learner and something learnable. Whatever model of the universe you suggest you have learned must be such that it contains learners and is learnable.

What is meant by learning, learner and learnable cannot be explained in terms of the Scientific Hypothesis or in terms of either of, or any, deterministic metaphysics. The new problem context of the Third metaphysics forces us to rethink our epistemology as well as our ontology: what is knowable/learnable and what is the nature of the reality we are learning or learning about.

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[53] Royce, Josiah, *The Religious Aspect of Philosophy* (1958) (Harper Torch Books)

Whatever it is that we have been learning in the history of science and engineering – it must be generally understood in terms of some sort of problem solving. And since problems are not real or meaningful in deterministic models, we must reflect and broaden our conception of the history of the human enterprise.

Royce offers a general formulation in what he refers to as the problem of problems. Any successful theory of the universe must be able to account for the occurrence of problems. Royce explores this line of reasoning quite productively – particularly in terms of the possibility of error (or mistakes). On the face of it there are two type of error: the analytic sort of error one might make in learning how something works and a design error where one is trying to improve a system or situation. With appropriate re-castings in the new problem context these become just aspects of one real type of error, associated with one real type of action and, inseparably, one real type of learning. This suggests a Third type of continuum.

Royce's Reflexive

Another implication of Royce's line of reasoning is that it is reflexive. The implication is that, given that I am not the only learner in the universe, the universe that I am learning about is also learning about me. This suggests an analogy with the evolutionary biology theme of co-evolution. The distributed learners in the universe are co-learning. And indeed if learning is an evolutionary – net directional – process then perhaps this co-learning and co-evolution are the same.

In other words, there is something in the nature of the universe – in the behavior of phenomena – that involves learning. The order governing the universe – the nature of the universe – involves a learning process.

The learning however is problematic – which is to say that it involves problem solving. The problem that the existential pragmatist is trying to solve is characteristically 'open'. Closed problems are those that allow one to converge on a final complete and consistent solution. Closed problems are associated with closed systems – where the possible states of the system are given – defining what can happen everywhere and always. The problem of the Scientific Research Program, by its very nature, aims to arrive at the final Theory of Everything – as a closed problem. An open problem doesn't make sense in a closed model of the universe – in any objective, deterministic model.

Open system models are inherently evolutionary and both quantitatively and qualitatively emergent. So the engineering enterprise is learning about how things work now in order to be able to develop – in effect 'open' the universe further. The enterprise is constructive and yet open. The engineer has no script or eternal set of skills. He is blind. But he can learn through experience.

Problem solving is building potential

The activity of the engineer, normally conceived, is constructive problem solving – improving how we live, the design of life and the universe as a whole. Improving the design is increasing the potential.

The concept of potential here can be developed in terms of the potential to perform work – in the sense associated with classical engineering thermodynamics. James Lovelock's research leading to the Gaia Hypothesis offers an insight as to the evidential basis of the notion that evolution is an engineering enterprise. Lovelock observed that the history of life on the planet earth represented an increase – both quantitatively and qualitatively – of the potential to perform work. There is an increase in the amount of life as well as the diversity of ways to make a living (viz. thermodynamically).

The Theological Reading of the Third Metaphysics

The problem of design is the problem of how to make the world better. Problem solving is – by its very nature – an attempt to improve the situation. Problem solving by its very nature seeks the good. This doesn't mean, as Socrates emphasized, that all action brings forth improvement. People make mistakes, misunderstand and miscalculate. But they also learn from these experiences. In a simple pragmatic expression the aim of the engineering enterprise is to bring value into the world, to bring new good things into the world.

The crucial point to understand is that we, the actors in this enterprise don't understand – in the beginning – how to do this. By investigating the world we learn how to develop it and ourselves.