NatureMind Theory

An Inquiry into The Logic of Possibility and Reality

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The scientific method is essentially a philosophy of empirically verifiable knowing, the success of which is more probable if we employ a proper understanding of *The Logic of Possibility and Reality*.

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Sections marked TW are being temporarily withheld from publication until the Inquiry is complete, so that they can be read in the context of the Inquiry as a whole.

Health Warning: **A Human Story**

Earth is the natural system which gave rise to us and which sustains our existence. Everything we do transforms this natural system in some degree. We cannot create or destroy Nature, we can only transform it for better or worse.

Earth is believed to have been created some 4.6 billion years ago, during which time benign geological and thriving biological systems have co-evolved in an interdependent planetary system supporting human life. Homo sapiens (that's us) has evolved to become the dominant species with two distinctive traits:

(1) The ability to radically transform our natural environment in order to expand our way of life;
(2) The intelligence and cognitive ability to ponder our existential state (who we are and our place in the natural world).

We have developed the means to travel and colonize virtually every habitable part of the world. In doing so we have displaced or driven to extinction other species, thus reducing the diversity of the biological system which gave birth to us and which nurtures us. Moreover, we have developed industrialized civilizations, the nature of which threatens the benign geothermal planetary system on which we depend for life.

As an animal species we can trace our anthropological history back to its zoological roots. Social species, of which we are one, generally organize along lines based on the nuclear family and the wider tribal family. Males compete for fertility rights, and function as hunters for food and warriors to compete over and defend tribal territory; whilst females select the strongest males with which to mate, raise young and become home makers. Such organization optimizes the biological furtherance of tribes living simple lives in a hostile environment, where conquest means survival and defeat can mean extinction. Accordingly, the power of strength and domination are the principal characteristics for success among the males; whilst the power of fertility, nurture, empathy and cooperation are the principal characteristics for success among the females. Typically, the tribal chief is the principal (alpha) male, whilst the females exercise power more subtly through their influence over the males. Thus the tribe is nominally patriarchal, but with a strong underlying matriarchal influence. Traces of these inherited primitive structures and traits remain in modern civilization, albeit in a more subtle and less clear-cut form.

As the dominant species we are top of the food chain with no natural predators to check our increasing numbers. In addition to which, we have adopted a growth system of political economy on a global scale which requires the consumption of diminishing natural resources at an ever-increasing rate in order to prevent the economy from collapsing. We are therefore placing ever-increasing pressure on a failing planetary system. This increases competition both within and between tribal nations for control of limited territorial rights and diminishing natural resources. In such an environment, the expansion of competitive trade develops into surrogate warfare, with the inevitability of spilling over into actual warfare as population numbers increase whilst the resources to support them decrease. This is exacerbated by the unequal distribution of world resources required to fuel modern economies. In this uneven global economy, underdeveloped countries which are rich in natural resources, such as timber and minerals, become pressured to exploit those resources in ways which impoverish them in real terms through loss of their natural environment to sustain them. The innocent victims of both surrogate and actual warfare are those who perish from lack of nutrition, untreated sickness, or are killed as collateral damage from armed conflict.

So our human numbers on the planet are being controlled to an extent, not by intelligent cognitive behaviour but by our human fallibility.

Competition in the form of both surrogate and actual warfare brings to the fore those

zoological characteristics of power through strength and domination, which are reflected in patriarchal (or meta-patriarchal) structures, macho politics and a predisposition towards resolving disputes through physical conflict. It is clear that the characteristics which were once optimal for survival in a primitive and limited way of life, are utterly nihilistic in a way of life for advanced global civilizations with the means to conduct warfare which could lead to Armageddon and the extinction of the human race. We are then in an existential crisis of our own making, which if we want to hang around a bit longer we must resolve with the utmost urgency. This brings us to the second of our evolved distinctive human characteristics: the intelligence and cognitive ability to ponder our existential state. Perception of our existential state has evolved through various stages such as animism, where all physical things are perceived to have a living spirit; to primitive superstition and uncertainty; to the emergence of belief in certainty through "revealed truth" in a supernaturally created universe. Such belief typically centres on an omnipotent creator which has, on condition of obedience, gifted our species an anthropocentric universe, where truthful knowledge is the preserve of guardians of the belief who are uniquely qualified to interpret the obscurities of its code. Be very sceptical of guardians of ***the*** truth! What in primitive tribes would be a witch doctor or shaman, has given way in more advanced societies to some form of spiritual leadership or priesthood. Inter-tribal conflicts are then greatly exacerbated by differences in interpretation of “absolute truth”; conflicts of belief which can tragically become literally explosive.

The notion of an anthropocentric universe was called into question in Renaissance 16th century by the development of the telescope which enabled astronomers to clearly observe the heliocentric motion of the planets, the revelation of which brought Copernicus and Galileo into conflict with the orthodoxy of spiritual leaders. It now turns out that we are a relatively small planet, spinning on our axis as we orbit a relatively small star in a cosmos filled with billions of stars. So we’re not so special after all! With the renaissance came the emergent belief in knowledge based on the rigorous testing of evidence through the precise analytical description of mathematical logic, with certainty giving way to probability, what we would now describe as ***The Scientific Method***. Scientific knowledge should transform the social landscape away from the overriding need for physical strength, domination and conquest. The very characteristics which once were necessary for survival in a primitive tribal environment, now present a growing threat to our survival in a global environment, where qualities such as nurture, empathy, cooperation and sharing – qualities commonly regarded as feminine – need to be allied to insight, comprehension and the need to live in accordance with the scientific revelation of principles and practices required for progress. Now a growing body of scientific knowledge is pointing to the realization that sustaining human civilization on our planet requires a radical transformation in our philosophy of life and living. Translated into practice: **Sustainability necessitates extracting our needs from Earth’s natural wealth without destroying it, and sharing out the proceeds.** So we need our best science and our best wisdom if we are to sustain the future of our species. Are we up to it?

Forever
There is only one who gives us birth
Father, mother, sister, brother
Only one Earth-Mother, Mother-Earth
She who gives us nurture
must in return we nurture
For if the music of the spheres
falls forever on deaf ears
There will be no ears
Forever

Complexity: A serious discourse with a twist of humour

Relativity Theory tells us that there are no absolutes, and the existence of all phenomena are necessarily relative to all other phenomena. From this we can conclude that the universe is holistically dynamic and in a constant state of change. So how can we mere mortals hope to understand and work within that degree of complexity? Complexity is the subjective perception of a multi-variant state of reality which, whilst fundamentally rational, borders on the incomprehensible without a proper recognition of the abstract metaphysical processes which give rise to it. However, science seems to have evolved pretty well so far, through a growing knowledge of the physics of Nature, without the need to perceive, let alone engage with, its metaphysics. Well, not quite! Scientific knowledge, founded on logic and empirical evidence, is made possible by our ability to detect and decipher the abstract metaphysical laws which govern the reality of the physical body of Nature at the level at which we perceive it. Now quantum physics is revealing a more fundamental level of Nature which cannot be explained by the classical laws of physics which were successfully used to explain it at our previous level of perception. Quantum Physics points to a subliminally subtle level of interdependence between the physical body and the metaphysical mind of Nature (see later). So, if we are to understand and work with Nature at this more fundamental level, as we must if we are to advance and survive as Homo sapiens, we need to get to grips with this intrinsic interdependency, which leads ineluctably to the concept of Nature as being holistically systemic; as opposed to reductively mechanistic.

One of the big debates in the early 20th century was among physicists seeking to make sense of the counter-intuitive nature of the newly discovered quantum physics, where the question of whether light is a wave or a particle was central. A conference was held in Solvay, Belgium in 1927, where all the physicist big-guns of their day were present (see below), which sought to find a degree of consensus. At the end, a proposition by the Danish Nobel physicist, Niels Bohr, was adopted. This proposition, known as ***The Copenhagen Interpretation***, was that there can be no certain state in the quantum world, where phenomena exist in all possible states until they are observed or measured. This led to the ***Schrödinger's Cat*** conundrum posed by Nobel physicist Erwin Schrödinger. If we were to place a cat in a box, together with a cylinder of lethal gas which has a random chance of being released, we would expect that when we opened the box there would be a 50% probability that the cat would be alive. On the other hand, in the quantum world the cat is both alive and dead until the instant the box is opened, when it is the act of opening the box and observing the cat which determines its fate. Counter-intuitive, indeed! Schrödinger set this out mathematically as a probability wave function, where the certain act of measurement causes the wave to collapse reducing the possible outcomes to just the one. Schrödinger's probability wave function has survived empirical tests over time with great success.

Einstein was not too keen on the Copenhagen Interpretation, but a well motivated cat instantly grasped its significance. My feline friend from next door, spotting my furrowed brow, explained it all to me. Yes, it was only a metaphor, and she'd rather stick Schrödinger in his box and let him take his chance. However, be that as it may, if we flip a coin in the air, it alternates between obverse side up and reverse side up until it comes to rest, when we would expect there to be a 50% probability of it showing obverse side up. Until that defining instant, the spinning coin's final state is indeterminate, oscillating between obverse and reverse side up. This indeterminacy can be expressed as an abstract sine wave (see below). If we intercept the spinning coin before it comes to rest and observe its upside state, the abstract wave of indeterminate possibility instantly collapses because the upside state is now determined. It is important to note that if our interception were an instant later the opposite side of the

coin would be its upside. My feline friend pointed out that the hypothetical cat is never *both dead-and-alive*; and in any case the indeterminate state is reserved for the mechanism which triggers the release of the lethal gas. That mechanism is like the spinning coin, with its final state being indeterminate until the instant it is determined.
"What is the determining factor, you may ask, John? I can't be definitive about that, but nothing can remain in an indeterminate state for ever: the spinning coin must eventually come to rest with its state determined. ***So indeterminacy is really deterministic-indeterminacy"***.
"In a dynamic universe, unexplained events arise all the time which determine states of indeterminacy; we refer to them as random chance. If the yes-no trigger mechanism remains indeterminate until the box is opened, the cat is still alive. If not, the cat is found dead when the box is opened. So, no *dead-and-alive cats*, thank you very much, but a trigger mechanism in a state of deterministic-indeterminacy with a random chance of firing. That's the basis of the success of Schrödinger's probability wave".
Schrödinger's wave equation addresses physics at the sub-atomic level, rather than spinning coins at our Earthly every-day level, however the principle of deterministic-indeterminacy still applies.
"The quantum universe highlights indeterminacy and random-chance determinacy.
So that's clear, then. And when it comes to mortifying a harmless moggie, Schrödinger's metaphor is decidedly foggy. To be fair to Einstein and his dislike of random chance (God doesn't play dice!), random chance is a term we apply to an event we cannot causally explain. However, logic tells us that nothing is truly without causal explanation, and that all events in the universe arise from causation".
The sine wave is a useful way of describing indeterminate states when there are just two alternating possibilities such as up or down, but how can we describe indeterminate states and their ultimate determination in cases where the number of possibilities is manifold? My friend explained that cats continually face complex problems which, if they don't solve successfully their nine-lives quota will be exhausted in just a single day.
"Now, John, I don't want you to accuse me of making an awful pun, but the answer to our multi-variant problem lies in Catastrophe Theory, which points up that Nature is fundamentally a dynamic system in which even the most stable structures are simply transient states of equilibrium over the course of time. Therefore, depending upon the robustness of the relationship between the dynamics of a system and the dynamics of its enabling environment, the system's equilibrium can be destabilized by even the smallest outside intervention. This principle is illustrated by the well known proposition that the fluttering of a butterfly's wings could destabilize the dynamics of a weather system and cause a hurricane. Or perhaps more plausibly, that just a sneeze on a snowy mountain when the stability of the snow is in a precarious dynamic state of equilibrium, could cause an avalanche. Or a breath of wind could destroy the balance of a tightrope walker. Or a house of cards can be brought down by the slightest disturbance. Or a hint of uncertainty can cause the flight of capital and bring down an elaborate financial institution. Or a critical mistake can de-stabilize and bring down a government.
So, John, it is inherent in even the most complex and seemingly stable system, that intervention by the smallest possible extraneous event is capable of upsetting its dynamic state of equilibrium, leading to a catastrophic cascade of events which only halts when a new systemic dynamic state of equilibrium is reached (e.g. the tightrope walker's safety net). It follows, John, that the universe at a fundamental level is an

indeterminate state of all possibilities until it is determined as a state of physical reality. That's how you get to perceive me every instant as a feline with the smug look of the cat that's got the cream. As for light, it is a particle oscillating at the highest frequency, whereby its precise location at any point in space and time is perceived as a probability wave, until it is determined as a particular event: a photon.

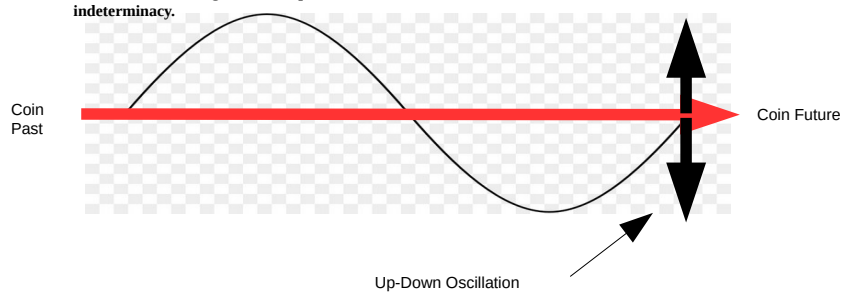
So, dear John, it really all comes down to a matter of cats' eyes and smart timing. And don't let anyone tell you about dumb animals. Have a good day!"

I explained that they don't award Nobel prizes to felines, whereupon she stated that a saucer of milk was more life-affirming than any lifeless gong or piece of paper.

"Anyway, Alfred Nobel, the benefactor whose name embellishes the award, was an arms manufacturer. It is a matter of extreme irony that Nobel rules-out posthumous awards". My feline friend has a life-affirming philosophy right after my own heart!

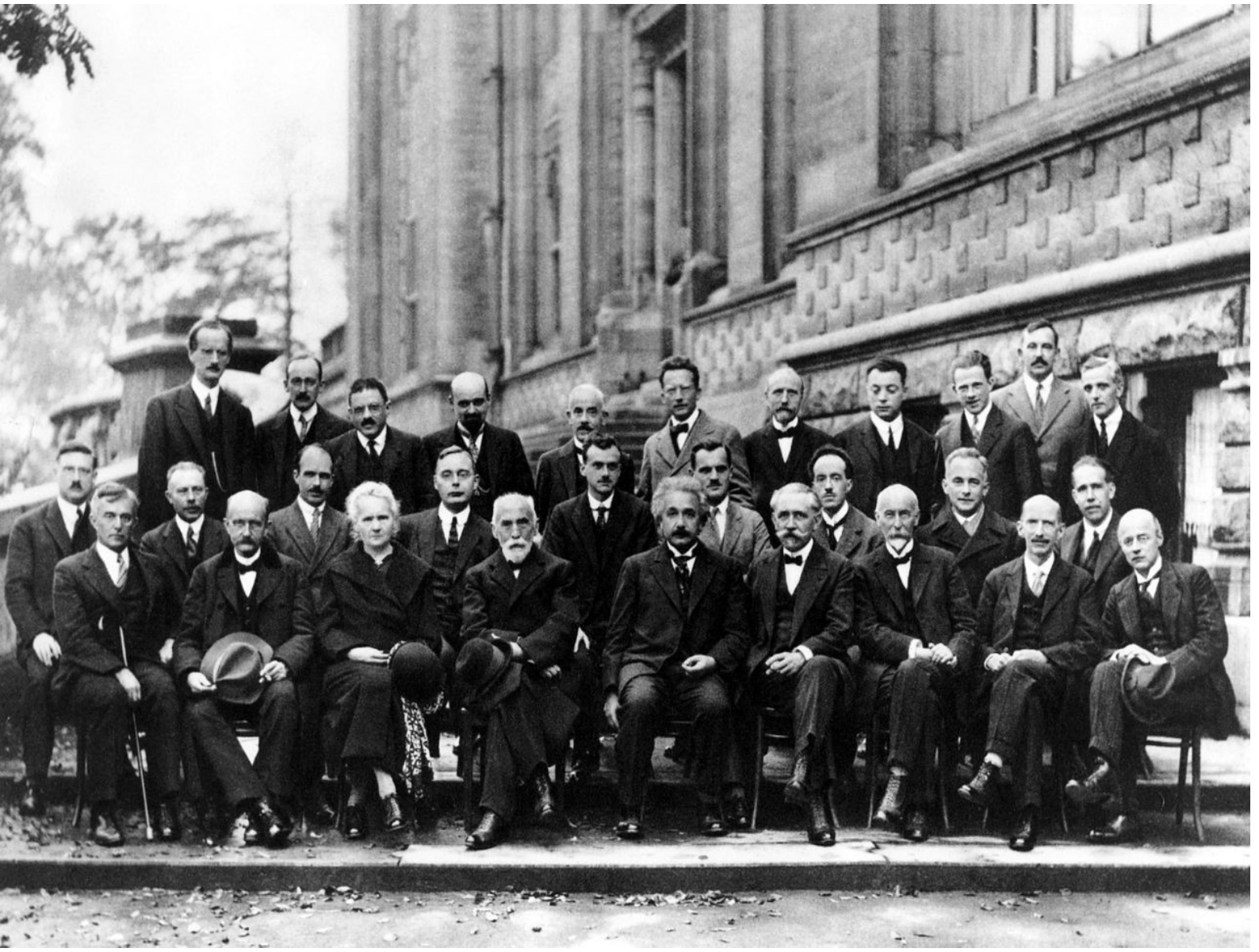
Figure 1

Graphical representation of the indeterminate state of a spinning coin (oscillating between obverse and reverse side up) prescribing a sine wave trajectory in space and time; with its mean value as a vector pointing in the direction of the future. Until the outcome is determined, resulting in the collapse of the wave, the coin is in a state of deterministic indeterminacy.



Each oscillation/wave is a discrete event

The class of 1927



1927 Solvay Conference on Quantum Mechanics. From back to front and from left to right: Auguste Piccard, Émile Henriot, Paul Ehrenfest, Édouard Herzen, Théophile de Donder, Erwin Schrödinger, Jules-Émile Verschaffelt, Wolfgang Pauli, Werner Heisenberg, Ralph Howard Fowler, Léon Brillouin, Peter Debye, Martin Knudsen, William Lawrence Bragg, Hendrik Anthony Kramers, Paul Dirac, Arthur Compton, Louis de Broglie, Max Born, Niels Bohr, Irving Langmuir, Max Planck, Marie Skłodowska Curie, Hendrik Lorentz, Albert Einstein, Paul Langevin, Charles-Eugène Guye, Charles Thomson Rees Wilson, Owen Willans Richardson

Note the all white-male line-up with one very notable exception, the redoubtable Marie Curie, double Nobel laureate (chemistry and physics). I doubt that anyone asked her to make the tea!

Logical Mind and Matter

Throughout this inquiry, reference is made to logic and the logical laws of nature.
So what is logic and logical natural law?
Logos "*The word*" taken from classical Greek, forms the subject of a massive body of philosophical study dating back to ancient philosophers such as Aristotle, Plato, Euclid and before. As intelligent, cognitive beings it is our nature to ponder the world in which we find ourselves and our place in it, and logic has evolved as a reasoned and structured way by which to ponder it. Reference to Wikipedia will show just how wide-ranging the field of study is. For the purposes of this inquiry, logic can be summed up by the broad definition "Reasoning conducted according to strict principles of validity". Formal logic is a set of rules governing the construction of abstract arguments such that their conclusions are necessarily valid; like the logic of mathematics. Their value is that they provide a format for constructing valid arguments about the state of the real-world. Such arguments seek to offer explanations for observed phenomena. An observation may be new or previously unexplained; or the argument may seek to correct, re-interpret or rebut a previous explanation which may have become incorporated into current orthodox thinking. The arguments should define the premises (given assumptions about the real-world) upon which they rest. Conclusions can then be realized by first setting out a field of alternative possibilities, then whittling down the field by a process of logical elimination to arrive at a single, logically valid conclusion (aka. deductive reasoning).
Arguments should be set out in such a manner that they can be logically tested, confirmed or rebutted. Arguments which assert propositions of fact should be supported by evidence, otherwise they must be treated as simply unsupported assertions.
The validation of a logical argument doesn't necessarily make it true. An argument may be consistent and logically structured but the premises (the unsupported assumptions) on which the argument is based may not be true, and in the real-world they are certainly incomplete.
Truth is an absolute concept in a relative world, so its use in real-world arguments is ill-advised because there are always alternative possibilities to the one being asserted.
So "logically valid" is an altogether wiser term. However in the abstract terms of formal logic it is possible to construct arguments with conclusions which must be true. Such is the syllogistic argument: "All ***A*** are ***B***. This is ***A*** therefore it must be ***B***". The conclusion must be true ***provided*** the premise that "All ***A*** are ***B***" is also true, and that what has been identified as ***A*** has been correctly identified as such, because there are no other possibilities as set out in the statement. The converse argument "All **A** are **B**, this is ***B*** therefore it must be ***A***" cannot always be true, because there may be cases of ***B*** which are not ***A***. For the case "All **A** are **B** *AND* All **B** are **A**" to simultaneously hold true, the underlying argument would be tautological. A tautology is where what is being defined ultimately defines that by which it is defined (the definiendum defines the definiens).

The formal rules of logic are crucial to reaching valid conclusions; and for statements to be meaningful they must be structured on logical rules of linguistics.
Words enable us to make qualitative statements about the real-world, or indeed about a world constructed purely in our imagination. The latter doesn't necessarily need to observe rules of logic. The art of farce, for example, is based on statements about the real-world which are intentionally illogical. But do look out for intended statements about the real-world which are fundamentally farcical. However before we can make a statement about the real-world we must first imagine (hypothesize) it. We can then test

and verify the validity of our hypothesis. Then, and only then, should we set out to assert our hypothesis as a logically valid theory about the real world.
Scientific theory is our subjective attempt to reveal the objective logical laws of nature which explain it. We can then utilize that body of knowledge to guide and enable human development and extend our existential presence in the universe.
Mathematics is a system of formal logic by which we can construct arguments to define metrics of the real-world. It is the logical manipulation of quantitative data as discrete events to give us the tools to explore, analyze and describe the objective world as we perceive it to be through our physical senses and in our metaphysical minds.
All constructs commence from points of origin. The scientific method requires that we subject the logic of our abstract mental constructs (hypotheses) to the test of physical experiment before we confirm them as probable descriptions of the real world; remembering that proving a hypothesis doesn't make it true. We are not omniscient; truth is for mystics who believe that they are, not for scientific rationalists who know they are not, and must maintain a healthy degree of uncertainty whatever the proof.
It is the logic of the arguments we make which validates their conclusions, not the logic of the language we use; although clearly they must go together. In other words, it is how logically we use the logical language of mathematics to make and test our arguments (hypotheses) which validates their conclusions. And in the absence of universal knowledge our conclusions must necessarily be couched in terms of probability not certainty, no matter how logically they are reached.
So in the interests of steering the best courses we can through the immense complexity of the real-world, let's drop any pretensions to certainty.
A postulate upon which any scientific understanding of Nature must be founded is that Nature exists and behaves according to universal laws of logic.
We can then use the laws of logic to explore, analyze, hypothesise and test theories about the nature of the physical universe of our experience. That enables us to formulate a body of empirically validated knowledge which we can apply, with a predicted confidence and reasoned caveats, so that the outcomes of our actions are more likely to fulfil our objectives.
In mathematics there are formal rules of logic, such as operational rules governing how we add, subtract, multiply and divide numbers. Equations are abstract arguments using discrete variables. Break the rules and we are behaving illogically, whether knowingly or not, because our actions are inconsistent with natural law to which we must adhere if we are to have any probability of achieving the objectives of our actions.
To propose that nature itself is governed by objectives is to propose teleology: that natural behaviour is determined by purpose. ***NatureMind Theory*** does not propose that nature's behaviour is in any way teleological.
Arguments about the real-world take as a starting point certain postulates regarding its nature. They are the first principles upon which our understanding of nature is rationalized. For example, Einstein postulated that for natural laws to obtain they must be the same everywhere and at all times in the universe. These are the premises (given assumptions) without which we could not begin to compute the effect of such laws.
Of course the postulates could prove ill founded, in which case we might have to re-think those first principles. A case in point is that it is assumed that the geometry of the universe is spherical. However the frame of reference we use to measure objects in motion in the universe is a cubic matrix consisting of three perpendicular spatial dimensions. ***So to be consistent with the assumption that the universe is a dynamic sphere, we need to adopt a frame of reference which best enables us to describe objects in motion within a spherical environment.*** This is addressed later in this Inquiry.

The structure of formal logic is an abstraction by which we can formulate real-world arguments. We can then test an argument to see whether or not it is logical. If it is we can say that the argument is logically valid. A mathematical equation is an argument about a particular state of the real-world, set in a logical framework whereby it can be tested to establish its validity; and solving the equation establishes the logical validity of the argument. Therefore the conclusion of an argument is binary: valid or invalid (avoid true or false). We use equations to make and test our theoretical arguments.
If the arguments turn out to be logically valid, we can say that the theories are confirmed. As has been argued above, the universe is dynamic, and therefore in a continuous state of change. In some cases that change may be rapid, and our theories need to acknowledge that nature exists in a fundamentally indeterminate state until the very instant it is determined. So when we come to apply equations to resolving real-world problems, the best we can hope for is not certainty (truth) but probability.
If we have an objective and we pursue it in ways which are known to be consistent with the achievement of that objective, then we behave logically. If on the other hand we behave in ways which are known to be inconsistent with, or even counter to, achieving our objective, then we behave illogically (irrationally). If we behave with no objective in mind at all, we are not being illogical, but are simply being aimless; which means we have no control whatsoever over the future outcomes arising from our behaviour, nor hope of success in resolving problems which confront us in our lives.
So logical behaviour is to set objectives and pursue them in ways which are consistent with their achievement. If we want to resolve problems logically, we should adopt a process whereby we define a problem we are seeking to address, set out the options available to us as a field of alternative possibilities, then through a deductive process of arguing the pros and cons of each, whittle down the field to arrive at what is seen as the optimum solution (the last entertained possibility left standing). Always remembering that there is no such thing as an isolated single issue in a universe of interdependency, and sometimes solving a problem in one area has unintended adverse consequences in another area. Where possible we should evaluate progress and test the stages of assessment empirically (by experiment) before acting on any conclusion. Where this is not possible we must rely on our judgement that our premises are correct and we have carried out the assessment process in the most logical way possible. Of course if the problem being addressed is quite literally a matter of life or death, and the objective is to preserve life, it is both logical and humane where possible to double check, seek independent expert opinion, then double check again before acting.
Natural process is instant real-time activity. So by the time we comprehend it, it is already out of date. Our academic text books are a compelling history of what we thought we knew yesterday. However, if we rely unquestioningly on what we thought we knew yesterday to inform our actions today, we will be ill equipped to face the new challenges of tomorrow.

The Objective Logic of Nature

Theoretical Science seeks to discover and reveal laws of nature which explain the physical universe which we experience and observe. It is axiomatic that universal laws must consistently obtain everywhere and at all times. Therefore the universe is intrinsically holistic, governed by abstract natural laws which, since they give rise to physical reality, must be beyond physical reality. Ergo, physical reality arises from the metaphysics of logical possibility. ***In simple terms, the logic of possibility and reality is binary: something is either possible and can be physically realized; or it is not possible and cannot be physically realized.*** In Boolean algebra, conditional testing, using 1 for "true" and 0 for "false" is the binary basis on which algorithms are

constructed to reduce complex problems, through a series of conditional tests, to ultimate conclusions. In so called "fuzzy logic", values are allowed to fall between 1 and 0, which implies both true and false (like Schrödinger's dead-and-alive cat). But that is because the outcome of the argument on which it is based remains indeterminate until a defining instant. The outcome of a spinning coin is ***deterministically-indeterminate*** because the conclusion of its oscillating true-false state will not be determined until the instant the coin comes to rest. When it does, it is binary logic which determines its objectively true or false conclusion.

Wisdom is holding to the most probable explanation until a more probable explanation comes along. That's how we progress!

The Logic of Possibility and Reality (The Unification of Metaphysics and Physics)

This inquiry proposes that Nature is expressed in two interdependent domains: ***Logical Process*** expressed as ***Metaphysical*Mind***; and ***Reality*** expressed as ***Physical Body***. Theoretical physicists seek to explain the fundamental properties of the material universe by revealing the abstract natural laws which govern them. In so doing they seek to read the logical mind of nature. This inquiry argues that the rationale governing Nature is the ***Logic of Possibility and Reality***, whereby physical events in the body of nature are realizations of logical possibility in the objective mind of nature.

This interdependence between metaphysical mind and physical body gives rise to the universe of events we observe, experience and of which we are ineluctably part.

* **Gk. Meta ta physika: beyond the physical.**

We all experience physical reality. But what is the possibility of physical reality and why? To quote Wikipedia:

Metaphysics is the branch of philosophy that examines the fundamental nature of reality, including the relationship between mind and matter, between substance and attribute, and between possibility and actuality. The word "metaphysics" comes from two Greek words that, together, literally mean "after or behind or among the [study of] the natural". It has been suggested that the term might have been coined by a first century CE editor who assembled various small selections of Aristotle's works into the treatise we now know by the name *Metaphysics* (*ta meta ta physika*, 'after the *Physics* ', another of Aristotle's works).

Note: The reference to CE means Common (or contemporary) Era.

Field of Possibility Defined

In NMT, a field of possibility is all possible alternative events which could follow on from the realization of an event – cause and possible effect.

The Nature of Probability: Deterministic-Indeterminacy

The distinction between the terms possibility and probability is vitally important in conveying logical information. Possibility is binary: logically events are either possible or impossible, they cannot be more or less possible. If they are possible there is some probability that they will occur (e.g. one in a million). Possibility without probability is a non-sequitur, so every possibility has some probability of realization, no matter how small (improbable) that probability might be in relation to the probability of alternative possibilities. As set out above, a field of possibility defines all the possible future outcomes which could result from the realization of a particular event (cause and possible effect). Alternative possibilities are mutually exclusive, so until an outcome is determined the field can be described as an abstract state of deterministic-indeterminacy, oscillating between the alternative possibilities. That is to say, while an outcome is certain to arise we cannot predict with certainty which one it will be, hence our predictions must be based on probability. For example, throwing a die gives rise to a field of possibility for the realization of one of six mutually exclusive outcomes; each with a one-in-six probability of realization. Until the die comes to rest, determining the outcome, ***the field of possibility in the objective mind of Nature can be described as***

being a state of deterministic-indeterminacy, whilst the subjective mind of an observer awaiting the outcome of the die throw can be described as a state of deterministic-uncertainty. ***It is important to acknowledge when predicting the probability of events, there is always the essential, if implicit, ceteris paribus (other things being equal) condition.*** For example, we assume a level playing field for the die throwing, such as there being no bias in the system; or that no exogenous event (outside interference) will occur to perturb the outcome before it comes to rest.

The Nature of Reality: The Certain Realization of Possibility

The sum of the probabilities of all possible outcomes arising from an event is 100% certainty of event realization. For example, if we hypothesize an event with 10 equally possible outcomes (degrees of freedom) the probability of any particular one of the possible outcomes being realized as an event is 1/10, and the collective probability that one of the possibilities will be realized is 10/10 = 100% certainty, there being no other possibility within the scope of the entertained (hypothesized) argument by which the conclusion is reached.

The Finite Nature of Possibility

As has just been described, all possibilities have some probability of realization, and event realization arises from the sum of all probabilities. The corollary is that no possibility can be realized independently of all other possibilities. So in the real world, the only field of possibility which can give rise to event realization (reality) is the field for the Universe as a whole. Therefore, all fields of possibility for event realization within the universe are necessarily interdependent sub-sets of ***The Universal Field of Possibility***, and no event within the universe can be realized – no matter how complex – without this interdependency. ***So, events arise holistically out of a finite Universal Field of Possibility, which means infinity (infinite possibility) is logically impossible to realize in the real-world***.

Since universal knowledge (omniscience) of objective reality is forever beyond our reach, any fields of possibility we can conceive are necessarily subjective and open to error from the perturbations of systemic interdependency.

The Cosmic Story: A Universal Drama

Dramatic performance requires dramatis personae (a cast of characters), space and time in which to perform, and a logical rationale to give coherence to the action.

Unlike most theatrical dramas, the universal drama has no author, script or predetermined storyline. It unfolds through causal action determined by a process of deterministic-indeterminacy (probability). The “Big Bang” opening scene gave rise to all possibilities regarding the future course the drama could take. That was a state of deterministic-indeterminacy until the instant it was determined (the spinning coin came to rest) in favour of the first step towards one possible story. ***In mathematical terms, The Big Bang gave rise to the maximum possible degrees of freedom for a future universe to evolve as a process whereby the degrees of freedom are finally whittled down to one conclusion. Thus the cosmic story will duly end bringing the curtain down on the universal drama.*** Hopefully, light cast upon the dramatic process will be used in life-affirming ways to advance human civilization and extend our role in the saga; otherwise Nature is a ruthless story editor when it comes to the cutting room floor! In any event, nothing can live forever, including the universe.

Deterministic-Indeterminacy, the probabilistic process whereby one possibility is realized (becomes reality) out of a field of mutually exclusive possibilities, is fundamental to the passage of the cosmic story. The intriguing question is how is indeterminacy determined. Being probabilistic rules out randomness as a determinant, so is there an overall governing process? This inquiry proposes that gravity is a logical process of self-organization (disentropy) to be revealed later in context, which determines the course of the universal drama.

Dynamic Universe

The universe is wholly dynamic, with every part – from the smallest particle to the largest object – being in a state of motion ***relative*** to every other part. The alternative would be absolute inertia, with no possible universal drama. Relative motion has two components: speed and direction.

Making Sense of Direction

Direction describes the orientation of something as pointing to or from parameters of a given contextual frame of reference (e.g. north, east, south, west; left, right, up, down, back, front).

Right-handedness

We tell stories by stringing letters of the alphabet together to form words and sentences etc. written sequentially in straight lines. There are rules of grammar governing how they are sequenced, such as syntax etc. but the importance here is that the stories are expressed within a linear system. In the western tradition, the lines are horizontal and the words are written left-to-right. The words could equally be written horizontally right-to-left, as they are in Arabic for example. Or in vertical columns, top to bottom, as they are in Chinese. So, our western tradition of writing left-to-right is arbitrarily "right-handed". Those of us who write with our left hand are "cack-handed" in the right-handed system and would undoubtedly find it easier writing right-to-left in a left-handed system.

The Two-handed Numbers System

Integers are a set of whole numbers arranged along a linear scale. There are no fractions, but, since they are discrete, there is an implied fixed spatial period separating the integers. It is a two-handed (left and right) system, with numbers sequenced in incremental order on either side of the origin at zero and extending indefinitely in opposite directions. Although it is a two-handed system, because of our western tradition of writing left-to-right our numerical system has a right-handed bias, with numbers to the right of zero being designated "positive", whilst those to the left of zero are designated "negative" (i.e. minus a left-to-right positive). Therefore, a move along the scale to the right is a positive move, whilst a move to the left is a negative move. For example, a move to the right of ten integers followed by a move to the left of eight integers is +10 -8 = +2; whilst a move to the right of ten integers followed by a move to the left of twelve integers is +10 -12 = -2. This right-handed bias throws up problems; for example, when we want to find the square root of a negative number, since no number multiplied by itself results in a negative number. Imaginary numbers were invented as a device to get around this problem. There is also an anomaly if we square a negative number, because that always results in a shift to a positive number to the right of zero. Multiplying negative and positive numbers together, is directionally illogical. For example multiplying -4 by +2 is like multiplying 4 steps to the south pole by 2 steps to the north pole. So the right-handed bias in our two-handed system means that

we must treat positive and negative numbers differently, when the only real difference between left-handedness and right-handedness is that they point in opposite directions. An unbiased two-handed system would overcome this problem by treating movements to the right and movements to the left as what they really are: not plus or minus, but movements in opposite directions. So, R and L would replace plus and minus, and a move to the right of ten integers followed by a move to the left of twelve integers would be R10,L12 = L2. In this unbiased two-handed system, powers and roots of numbers on either side of zero would be treated the same; negative numbers would be done away with, and with them the tricky problem of their square roots etc.
R and L can be complemented by U (up), D (down), F (forward) and B (backward) to quantify movement in six perpendicular directions from a zero point of origin.
Zero (0) having no direction does not qualify as a number, since numbers (integers) are essentially measures of distance from zero. Zero is simply a point of origin, a starting point for directional movement. Consequently, zero cannot logically be used as a numerical operator, such as in multiplication or division. For example, we should not try to divide into zero, or divide by zero because it is just not a directionally logical thing to do.
A vector is an arrow quantifying spatial movement. Numbers quantifying spatial movement can be described by vectors starting in length from zero and pointing in the direction of movement. For example, replacing positive and negative numbers with left and right vectors would result in the following changes:-

+4 -2 = +2	is replaced by	R4,L2 = R2
-4 -2 = -6	ditto	L4,L2 = L6
+4 +2 = +6	ditto	R4,R2 = R6
-4 +2 = -2	ditto	L4,R2 = L2
-4 x -2 = +8	is replaced by	L4 x L2 = L8 (note the difference)
-4 x +2 = -8	not directionally logical, so no possible replacement	
+4 x +2 = +8	is replaced by	R4 x R2 = R8
+4 x -2 = -8	not directionally logical, so no possible replacement	
-4 ÷ -2 = +2	is replaced by	L4/L2 = L2 (Note the difference)
-4 ÷ +2 = -2	not directionally logical, so no possible replacement	
+4 ÷ +2 = +2	is replaced by	R4/R2 = R2
+4 ÷ -2 = -2	not directionally logical, so no possible replacement	
+2 ÷ -4 = -1/2	not directionally logical, so no possible replacement	
+2 ÷ +4 = +1/2	is replaced by	R2/R4 = R1/2
-2 ÷ -4 = +1/2	is replaced by	L2/L4 = L1/2 (Note the difference)
-2 ÷ +4 = -1/2	not directionally logical, so no possible replacement	

In the case of accounting, instead of numbers being prefixed R and L they would be C and D for credit and debit as per current convention. Whilst company balance sheets would be P and L for profit and loss as per current convention.
Numbers enable us to count discrete phenomena, which is the essence of quantification.

Vector Quantity v Scalar Quantity
Vector quantities expand from a point of origin in a single direction, and are described by the length and direction of arrows (vectors). For example a vector describes the straight-line direction (degrees) and distance (kilometres) between London and Newcastle within the frame of reference of a two dimensional map.
On the other hand, scalar quantities expand from a point of origin in all possible directions. A scalar quantity describes the expanding area of a two dimensional concentric circle, or the expanding volume of a concentric sphere in three dimensions. Vectors and scalars are interrelated in that vectors form the radii of circles and spheres,

and the area of a circle ($\mathbf{A = \pi r^2}$) and the volume of a sphere ($\mathbf{V = 4/3\pi r^3}$) are equivalent to the integration of all their possible discrete radial vectors.
We can rank all systems in the universe, and the objects within them, in terms of their difference in scale. For example the difference in scale between the microcosmic universe of sub-atomic particles, and the cosmic universe of galactic systems of stars and planets. In between there is the geological scale of Earth and its systems and beings with which we are familiar, and by which we measure our lives and ponder the scales of the smallest and largest possible systems, and seek to relate them to our own scale.
The logarithmic scale relates numbers to the power that a base number must be raised to realize them. For example the decimal number system relates numbers to which 10 must be raised to realize them:
$10^0 = 1$, $10^1 = 10$, $10^2 = 100$ etc.

SpaceTime: The *Where, When* and Speed at which *Action in The Universal Drama is Realized*
In a holistically dynamic universe, with all objects in states of motion relative to all others, the universal drama cannot perform in space or in time alone. Every action in the drama is a unique SpaceTime event, with a spatial period (e.g. metres) and a temporal period (e.g. seconds) determining where, when and the speed at which it arises relative to the events which gave rise to it – cause and effect – as the drama unfolds; allowing for the universally interdependent context of the drama.
SpaceTime events are instances of objects in motion, where a key metric in determining their motion is their mass. The nature of mass will be addressed later, meanwhile we can consider it to be a quantity related to weight.
A SpaceTime period is a specific trajectory of SpaceTime events, and a passage in the universal drama. A dramatic passage can only be realized if its SpaceTime period is possible. For example, Romeo may woo Juliet from beneath her balcony, but he can't get to kiss her unless he can shin up to the balcony before her mum turns up to scold her and draw her indoors (the Capulets were real spoilsports when it came Juliet's right to choose her sweetheart). So whether or not Romeo gets a kiss depends upon his ability to dramatically realize the SpaceTime Period between them.

Frames of Reference: The orientation of SpaceTime events
A frame of reference is a subjective construct which enables us to specify where and when a SpaceTime event arose relative to the parameters of the frame of reference.
To enable such references to be made, the frame of reference needs to be at rest relative to the observer. For example, the map of the London underground relates a simplified spatial relationship of all the stations in the network to the observer who is at rest to it. If the map and the observer are in relative motion, the information on the map is likely to be blurred and incomprehensible to the observer, depending upon their relative speed. As each of us observes the world around us, we relate what we see to physical and/or metaphysical (imaginary) frames of reference which give it context. Logically, without frames of reference we cannot make verifiable statements about the SpaceTime existence of phenomena.
A reference grid imposed on the map of a geographical area is a two dimensioned frame of reference which enables us to relate locations such as **A** and **B** to each other by quantifying the direction and distance between them. However, to actually travel between **A** and **B** the journey must be realized as a dynamic trajectory of SpaceTime events (a SpaceTime period), which takes account of the non-linear nature of the route and the speed at which we travel it. If you are riding your bike from **A** to **B**, then every second by your watch is a SpaceTime event which can be recorded as an instant point vector (micro-arrow), as it would be on a satnav.
In the case of the frame of reference for Earthly drama, who says it better than

Shakespeare: "*All the world's a stage*". We can then place a terrestrial performance in the context of the universal drama.

Symmetry: Dynamic Equilibrium

Something is perceived as being symmetrical in form if it can be divided in half, with each half being the mirror image of the other, pointing in opposite directions from the dividing line, ***the axis of symmetry***.

The two-handed ***NMT*** numbers system is symmetrical in one dimension, with right-handed (R) numbers defining possible trajectories of SpaceTime events pointing to the right of zero (the point of origin and axis of symmetry) whilst left-handed (L) numbers define possible trajectories of SpaceTime events pointing to the left of zero. If we add possible trajectories of SpaceTime events pointing upwards (U) or downwards (D) of zero, and possible trajectories of SpaceTime events pointing backwards (B) or forwards (F) of zero then we arrive at a three dimensional symmetrical framework for the quantification of all possible trajectories of SpaceTime events from an axis point of origin. So the axes of our symmetrical framework should be depicted by vectors (more later in the section ***A Spherical Frame of Reference for Motion in Six Directional Dimensions***). This contrasts with the orthodox "Cartesian" frame of reference. Furthermore, by including negative direction from a point of origin, the three spatial dimensions of the Cartesian frame of reference are not symmetrical since they embrace the concept of negative space. Negative space may have utility as an entertained hypothesis in our subjective metaphysical minds, as we try to figure out the objective logic of the metaphysical mind of Nature, but it has no known possibility of physical realization.

In dynamic terms, a field of possibility is a symmetrical framework, oscillating between mutually exclusive trajectories from a point of origin (equilibrium). The instant one of the possibilities is determined (by extraneous intervention) the symmetrical state of indeterminate possibility collapses giving rise to the asymmetry of a specific SpaceTime trajectory. Extraneous intervention also collapses the indeterminate symmetry of possible clockwise or anti-clockwise motion, into the asymmetry of actual clockwise or anti-clockwise motion. We are of course interested in forecasting that state of physical SpaceTime reality.

When we seek a solution to a physical problem, we resort to the metaphysics of logical possibility. Then we seek to test any resultant solution empirically to see if it works. Once a possibility is realized as an actual SpaceTime trajectory, its motion in one of the possible directions from the point of origin is necessarily asymmetric.

Symmetry is a perspective relative to the frame of reference in which it is viewed, so we can transform the symmetry of our right-left directional numbers system by rotating it about the point of origin. For example, if we rotate it 90^0 clockwise, right-left becomes down-up. If we continue the rotation, down-up transforms into left-right, and so forth. Alternatively we can rotate the frame of reference to gain different perspectives (we can look at it from different directions).

Dynamic symmetry of form is the image of an object from the perspective of an observer at rest with the object. That is to say it is symmetrical in terms of the dynamics of the light particles transmitting the image of the object to the observer. If we drive a car at 100 mph, and another car is driving at 100 mph alongside us, the driver of the other car is at rest relative to us, just as if sitting next to us (at rest means zero relative velocity). The symmetry of the image becomes asymmetric when the object and the observer are in motion relative to each other; that is the essence of relativity which is addressed later in this inquiry. What can be said here is that dynamic symmetry is a relatively at-rest state of indeterminate possibility for asymmetric motion. Thus ***"relatively at rest" is a state of equilibrium, dynamically balanced between possible states of asymmetric motion***.

In more abstract terms, a mathematical equation is a statement of dynamic symmetry. For example, quantity **A** measured in one direction from zero is equivalent to quantity **B** measured in the opposite direction. Zero, the axis of dynamic symmetry is the point of equilibrium. We don't think of the opposite sides of an equation as having different directions, but all SpaceTime events arise in directional context which determines their relativity. For example 100 miles north of the equator is equivalent in distance to 100 miles south of the equator, but those equivalent distances gain contextual meaning in terms of their relative SpaceTime motion.

Equilibrium is why we can stand upright without falling over – at least when we're sober. Otherwise we lose equilibrium and swiftly go dynamically asymmetric!

A boulder rolling down a hill is a trajectory of continually changing geometric form viewed from the relative perspective of an observer. However, its underlying dynamic structure, whilst adjusting to changes in stress, will remain in equilibrium (dynamic symmetry) unless it shatters on impact.

A trajectory of SpaceTime events tells a story. We normally associate stories with words, however in order to convey a story the words must describe a trajectory of SpaceTime Events (real or imagined). If the story is realized as a physical drama, it can be quantified, and its dynamics described mathematically – using numbers ordered in logical operating processes such as multiplication.

Physical structures are fundamentally dynamic interrelationships of particulate SpaceTime events. So what we perceive to be a solid or rigid geometric form is fundamentally an equilibrium state of particulate interactions which might be described as a field of possibility. For such interactions to form coherent structures they must do so as systemic cycles of SpaceTime events. ***The longevity of any structure depends upon how long its systemic cycle is supported by the interactive dynamics of its enabling environment.*** Every SpaceTime event is a discrete instance, causally determined by the event(s) which gave rise to it. So a trajectory can be visualized as a chain of vectors linking the SpaceTime events. Every SpaceTime event is a fleeting instance where the future asymmetric direction of the trajectory is determined. So what if a least-optimal turn is taken? Well life's journey is beset with many wrong turns; possibly including conclusions reached in this Inquiry. ***In a world of indeterminate probability, evolution arises as transformation through a heuristic process of trial and error; something which we subjectively call learning from experience.*** That natural process can be mimicked by the algorithms of artificial intelligence (AI).

The dynamics of the chair on which you may be sitting, consists of a complex pattern of SpaceTime events in a state of equilibrium caused by gravity acting upon it and you sitting on it. Equilibrium can be described by the logic of an equation, or in the case of AI by the iterative process (repetitive feedback) of an algorithmic logic loop (like a thermostat maintaining a mean temperature in a central-heating system). The chair's dynamics change with use, so a comprehensive equation will take account of wear-and-tear; and the dynamic structure of the chair, like every structure in systemic Nature, evolves as a cycle of birth, life and death SpaceTime events.

Continuous trajectories are cyclical movement, such as trajectories around Earth or other cyclical trajectories within the universe. Cyclical (including reciprocating) motion is fundamental mechanics and arises in every mechanism, such as the wheels on your bike when it is in motion. But even when your bike wheel is relatively "at rest", it is in a dynamic state of equilibrium, transformed into a state of disequilibrium (asymmetric motion) when you ride off.

When cyclical motion is rapid, we describe it as spin, like the spinning wheel of your bike as it transports you in the direction you want to go.

If the outcome of symmetrical probability were to be simultaneous asymmetric

motion in both opposite directions, we could have twin objects with opposite spins. Then collision and annihilation becomes a possible outcome. If The Big Bang gave simultaneous rise to alternative universal dramas, then we would have brothers and sisters in an antiverse, who if we were to meet we would mutually annihilate. There is subjective metaphysical material here for a science fiction writer to anti-spin a cosmic drama. If our universe were to meet its antiverse, they would annihilate each other (a destructive Big Bang event). We would definitely need to avoid meeting our anti-selves. Makings of a Hollywood blockbuster! Of course this is all entertained supposition (imagination). However, we can say that the instant the curtain went up on the universal drama, was an instant of symmetrical possibility, in which any one of all possible universal stories could be realized. The instant the universal drama commenced, it gave rise to an asymmetric trajectory of SpaceTime events telling the story of its birth, its ongoing life, and predicting its eventual death.
So far dynamics have been considered in terms of the realization of trajectories of SpaceTime events. However we think of dynamics as concerning the motion of objects which possess mass, requiring force to move them. Objects, apart from the fundamental particles of matter, have structural mass which are interactions between particulate SpaceTime events. So we can consider a matter particle to be the realization of a particulate SpaceTime event; and a body to be a complex pattern of trajectories of particulate SpaceTime events in an equilibrium state of dynamic symmetry (more on this later).
The dynamics of transformational symmetry (dynamic equilibrium) making and breaking is a fundamental property in nature, which will be returned to later.

Cyclical Nature and the Frequency of its Realization
All motion is intrinsically cyclical. If we walk, we take steps which are cyclical motion. If we bicycle, the motion of our pedals and wheels are clearly cyclical. If we travel by car or any mechanical means, the engines and wheels perform cycles. If we fly, the aeroplane engines also work in cycles. Even if we glide, the air thermals which enable us to stay aloft are cyclical. Weather, tides and ocean currents all move in cycles, as do particles and planets. And deep beneath our feet, the tectonic plates, on which the continents move slowly but massively in geothermal cycles, giving rise to periodic friction leading to earthquakes and volcanic eruptions.
As shown earlier, infinity has no probability of realization, so logically the only means of continuous motion in a finite world is cyclical – just as the finite environment of a goldfish bowl confines the motion of the fish to an endless system of cycles. We can change the goldfish environment by placing other objects in the bowl, such as additional fish, which act to transform the system into more complex cycles. Unlike goldfish world, human world has greater degrees of freedom to express its systemic complexity, and the human body itself is a complex system of cycles. So systems are definitively cyclical; but cycles never visit the exact same place twice, because SpaceTime events are in a constant state of change. For example, when you leave home in the morning and return in the evening, you and your house are intrinsically different SpaceTime events because you have both aged. Moreover, as people and things age their future possibilities diminish and converge towards their terminal SpaceTime events. ***So all phenomena consist of SpaceTime cycles of birth, life and death events.***
When we gaze out into the cosmos we see that the planets, stars and galaxies are all moving systemically in complex cycles. Indeed the universe itself is a system of cyclical motion within the finite confines of the cosmic “goldfish bowl”. Unlike the real goldfish bowl, which is finite due to its hard physical boundary, the universe is finite with no equivalent to a hard boundary. ***As set out earlier probability is finite, which***

logically sets the limit to linear distance (vector scale) in the universe. Moreover, SpaceTime events within a field of possibility are mutually exclusive, so the realization of some, reduces future possibilities in an ordered process of disentropy towards the ultimate conclusion of the universal drama. Until then, action in the drama is restricted to cyclical trajectories of SpaceTime events, and ***cyclical motion is fundamentally SpaceTime oscillation***.

A sphere, relatively "at rest" in the context in which it is viewed, is a perfectly symmetrical three dimensioned form. A plane taken through the centre of a solid sphere relatively at rest is a disc. In a wholly dynamic universe, the disc relatively at rest is in an indeterminate state of equilibrium, oscillating between the possibilities of rotating clockwise or anti-clockwise (or possibly flipping over). The upper image in ***Figure 2*** depicts the disc with its ***horizontal axis of symmetry*** (a diameter), and **P** is a point on the circumference. When the disc is rotated, **P** becomes a cyclical trajectory of SpaceTime events, with its SpaceTime period being the complete cycle.

It is P's movement about the axis of symmetry during the disc's rotation, that we are interested in. Initially the movement is zero because **P** is on the axis at "9am". When the disc turns in the clockwise direction, the movement is initially **upward of the axis** when it gradually increases until it maximizes at the "12 am" position. After which it gradually decreases until it reaches the "3 pm" position, when it again becomes zero. The movement then increases **downward of the axis**, when it maximizes at "6pm". The final quarter of rotation leads to the movement decreasing until it again reaches zero at "9pm". We can see that if the disc were a clock, **P**'s trajectory would represent a half day cycle of what we call "time", with periods of SpaceTime events, such as seconds, minutes and hours, comprising the half day cycle. Halve the speed of the rotation and we have a 24 hour cycle. The end of each one second cycle on our clocks is marked by an audible event: a tick.

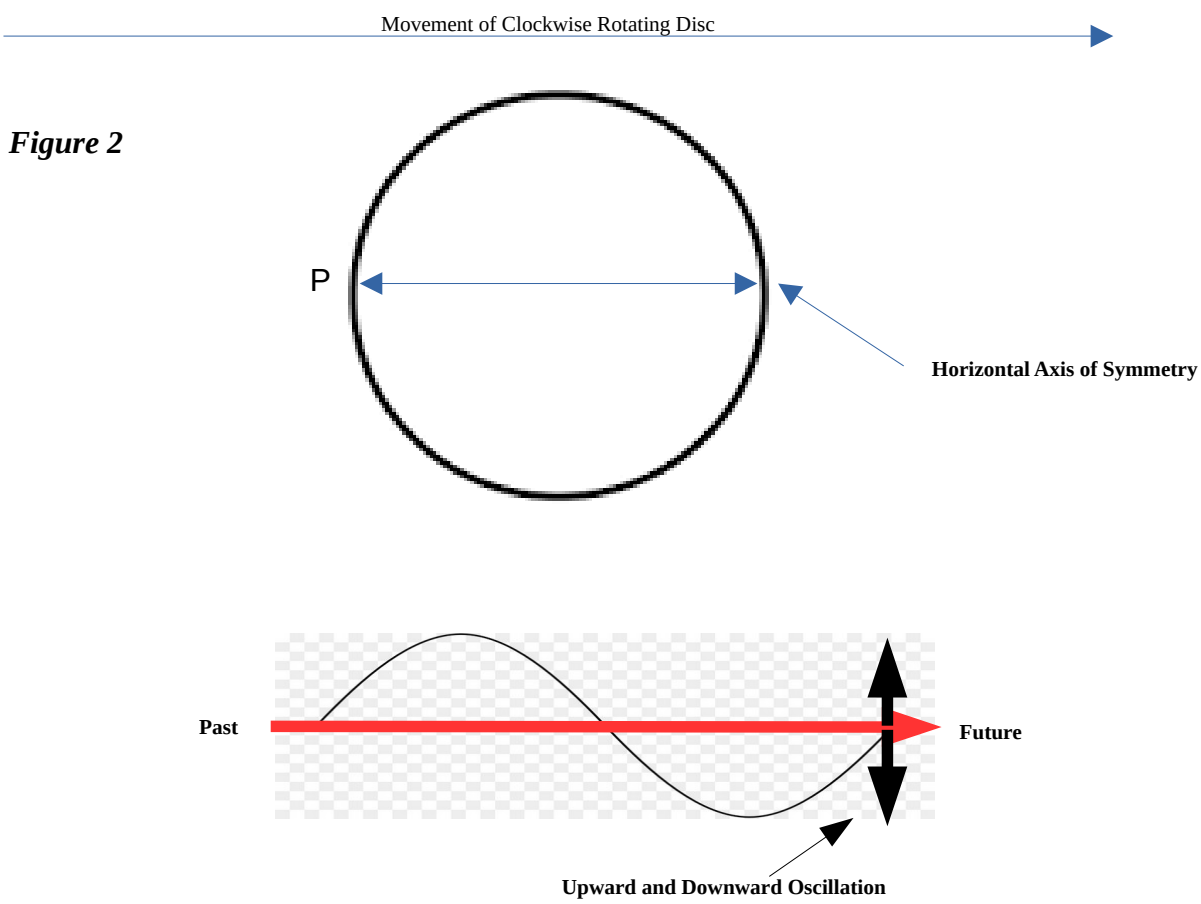


Figure 2

The lower image depicts the oscillation of **P** in one dimension – upwards and downwards of the axis of symmetry – whilst simultaneously tracing its trajectory in a second dimension, as a left-to-right sine wave. The height of the wave equals the radius (**r**) of the rotating disc, and the length of its wave trajectory equals the disc's circumference (**2πr**). The red arrow is the axis of symmetry along which **P's** mean SpaceTime trajectory is measured (the conventional wavelength). We can see that the size of the wave is directly proportionate to the scale of the rotating disc: a larger scale disc generates a proportionately larger wave. And the frequency of the wave is the frequency at which the disc rotates (oscillates). ***In general, motion is defined by the scale of its spatial oscillation and the frequency at which it occurs. For as long as the disc freely rotates, P will continue to oscillate at the constant frequency.***

If **P's** oscillating cycle were to start at 12 noon, it would have a ***vertical axis of symmetry,*** which gives oscillation **leftward** and **rightward of the axis**. So **P's** oscillation depends upon the scale of its cycle, the plane in which it commences its cycle, its direction (clockwise or anti-clockwise) and the frequency at which it occurs. Moreover, in the wider picture rotating discs are simply planes through the centre of rotating spherical objects, from particles to planets. ***So P's cyclical motion is part of a system of integrated cycles (oscillations) on scales up to that of the Universe itself.***

A sphere can rotate (spin) in any one of all possible directions relative to the frame of reference in which it is viewed, and as it does so it oscillates about its relevant axis of symmetry (***not to be confused with its axis of rotation, which is the hub of the rotating sphere***).

To sum up, oscillation in one dimension is the SpaceTime dispersion of an object's motion about a point of origin. In two dimensions it forms the trajectory of a traveling wave, where its length is the SpaceTime period of its occurrence, and its speed is its frequency of occurrence.

So we have derived a two dimensional wave from a moving object, where the frequency of the wave is the frequency at which the object oscillates, and the length of the wave is the spatial period of the object's oscillation.

Only a weightless object can be accelerated to the universal maximum possible oscillating frequency (speed) which is restricted to the smallest possible object with the shortest possible wavelength. Thus it has the oscillating frequency of a fundamental particle, such as a particle of light (a photon). On Earth, a weighty rotating disc becomes a moving wheel, recording its oscillating frequency in say, miles per hour.

We have established that the universal field of possibility is finite, placing logical limits to the linear trajectory of SpaceTime periods. ***The Planck length*** (Max Planck, 1858-1947) is deemed to be the shortest possible measurable length (SpaceTime period) represented by the shortest possible wave trajectory, oscillating at the greatest possible frequency. Conversely, the longest possible measurable length (SpaceTime period) would be the longest possible wave trajectory, oscillating at the least possible oscillating frequency. That would representing one rotation of the universe at the lowest speed; motion which would be as near as is possible to inertia, at a temperature as near as is possible to absolute zero.

We have seen that natural cycles (oscillations) are fundamental to our existence, and in order to quantify their description we need oscillating measuring instruments to do so. Accordingly we measure the frequencies of SpaceTime events relative to the constant SpaceTime oscillating frequency of our clocks (see **Clock Time** later).

We have established that Nature is a system of complex cycles arising within finite boundaries; rendering it possible to predict SpaceTime events within a range of probability. Thus providing the basis for our scientific understanding of the metaphysical laws which give rise to the physical reality of our experience.

What we must learn from Nature is not to break its cycles. Political economy is the dominant philosophy in the modern human world, and determines how we assign scarce resources – be it by free market or by state intervention – and growth per se is the sine qua non of modern economic theory. The term Economics is derived from the ancient Greek, ecos nomos, meaning household management. In ancient Greece the household would have extended to the city state, such as Athens. Now we have a global household. The pursuit of endless extraction, and the creation of subsequent waste, violates Nature's SpaceTime cycles, and is therefore both futile in terms of our welfare and catastrophic for our planet home. In effect, the pursuit of limitless growth is "managing our global household" by pulling its structure down about our heads.
So economists, like the rest of us, must learn from the logic of possibility and reality and evolve the practice of cyclical economies in-step with the cycles of Nature. Therefore it would be wise of Homo sapiens (Wise Man) to abandon the futile pursuit of the logically impossible in favour of the logically possible. It would also prolong our presence in our planet household a little longer. Of course, when cycles can can no longer be sustained, they must end. ***So all phenomena must experience birth, life and death cycles, including Earth, Sun and the whole universe.*** Recycling is a natural phenomenon, and the logical process which gave birth to our universe of cycles will ultimately recycle it to a successor universe of wholly new cyclical patterns (although its logical laws will remain the same). Intrinsic to the nature of cycles is the relative frequencies at which they occur. Quote Wikipedia: "The **hertz** (symbol: **Hz**) is the unit of frequency in the International System of Units (SI) and is defined as one cycle per second. It is named after Heinrich Rudolf Hertz (1857–1894), the first person to provide conclusive proof of the existence of electromagnetic waves. Hertz are commonly expressed in multiples: kilohertz (10^3Hz, kHz), megahertz (10^6Hz, MHz), gigahertz (10^9Hz, GHz), terahertz (10^{12}Hz, THz). Some of the unit's most common uses are in the description of sine waves and musical tones, particularly those used in radio and audio-related applications. It is also used to describe the clock speeds at which computers and other electronics are driven. The units are sometimes also used as a representation of the energy of a photon, via the Planck relation $E=h\nu$, where E is the photon's energy, ν is its frequency, and the proportionality constant h is Planck's constant". Now we have seen that the SpaceTime trajectory of an object, is intrinsically a wave cycle, from the scale of an elementary particle upwards. Something to think about while you are cycling home!

The Misconception of Independent Space or Time
The common perception of space or time as independent realities is, as stated earlier, erroneous. ***Nothing can exist in space or in time alone.*** Nevertheless we generally tend to consider them as independent. So, let's consider the space-time conundrum.

Space: The Field of Potential in which Trajectories of SpaceTime events are Realized
Scientists, among them Newton and Einstein, have struggled to understand the nature of space as an entity which enables both the propagation of electro-magnetic radiation (such as the transmission of light) and the mechanics of celestial bodies (such as the motion of planets). Surely then space must be some sort of medium. So it was hypothesized that space is a form of substance, termed the luminiferous ether (aether) through which light and planets travel. In 1887 Albert Michelson and Edward Morley conducted an extensive series of experiments aimed at detecting an ether, but without success. So the Michelson-Morley experiments became a scientific benchmark for the ether's non-existence. However Einstein was reluctant to let it go, insisting that an ether was essential to his theory of relativity. In 1920 he presented a paper in Leiden in which

he stated, inter-alia, the following: **"The ether of the general theory of relativity is a medium which is itself devoid of all mechanical and kinematical qualities, but helps to determine mechanical (and electromagnetic) events"……. "Recapitulating, we may say that according to the general theory of relativity space is endowed with physical qualities; in this sense, therefore, there exists an ether. According to the general theory of relativity space without ether is unthinkable; for in such space there not only would be no propagation of light, but also no possibility of existence for standards of space and time (measuring-rods and clocks), nor therefore any space-time intervals in the physical sense. But this ether may not be thought of as endowed with the quality characteristic of ponderable media, as consisting of parts which may be tracked in time. The idea of motion may not be applied to it".**

It seems then that space is something of an enigma, an undetectable domain in which the physical properties of matter in motion arise. Empty space is termed ***the void***, which means it has no physical presence. However, difficulties with the nature of space can be resolved if we consider space, not in terms of a physical entity, but as a field of potential in which trajectories of SpaceTime events are realized to comprise the physical body of Nature.

The detection of physical phenomena requires a physical reaction by that phenomena to the means of detection to reveal its presence, which of course is quite impossible if the phenomena being sought is simply a field of unrealized potential. So empty space is intrinsically undetectable, open only to metaphysical hypothesis. In cosmic terms, space is the abstract field of potential in which the unfinished universal drama is unfolding every instant. In order to comprehend the nature of that drama we must analyze the story so far, embodied in trajectories of SpaceTime events.

For us, the most ubiquitous trajectory of SpaceTime events is visible light. Mostly it is light emitted from our star, the Sun. Our sky is lit up by photons interacting with molecules in Earth's atmosphere. In that way our atmosphere shields us from the most damaging of Sun's radiation. Our night sky is dappled with a profusion of stars which we see by the light they emit as trajectories of photons carrying their image.

Fundamentally, everything we see arises at the speed of light. So what we "see" are SpaceTime light-borne images. When we see a celestial object other than one which is emitting light, such as our moon, its image comes to us as trajectories of reflected light. So what we perceive as space is either filled by trajectories of SpaceTime events, or it is a field of potential perceived as "empty space" when we see nothing. What stands between us and Moon is not physical space, it is a field of potential for the realization of trajectories of SpaceTime events, such as trajectories of SpaceTime "photon" events. It is also a gravitational field (see later). So, when we travel to Moon it is the instant-by-instant realization of a trajectory of "spaceship" SpaceTime events.

To sum up, space is a field of potential for the realization of trajectories of SpaceTime events, perceived as three dimensional objects in motion, which make up the physical universe. ***A SpaceTime event measures the where, when and speed at which the event arose relative to the causal event(s) which gave rise to it.***

Clock Time: The oscillator by which we measure the frequency of SpaceTime events

Figure 3

We have seen that physical reality arises as trajectories of SpaceTime events which are intrinsically cyclical. W***e measure the frequencies of those cycles using clocks which are oscillators calibrated to the constant frequency at which Earth rotates eastward on its axis relative to the Sun, whereby one period of angular rotation (oscillation) equals one 24 hour daily cycle.*** Minutes are degrees of angular rotation in the 24 hour cycle. So 1440 minutes / 360 degrees = 4 minutes per degree. Looked at differently, seconds, minutes and hours are frequencies of intermediate SpaceTime events during the daily cycle.

Earth's circumference at the equator is 40,075 kms, so the speed of Earth's rotation is 40,075/24 = 1,670 kms per hour. We don't feel the slipstream because, due to gravity Earth drags its atmosphere around with it.

The line of longitude which constitutes the point on Earth at which its rotation is related to the position of the Sun to mark the passing of a day, is by international convention the Greenwich Meridian, and Greenwich Mean Time is a reference for calibrating time zones around the world. Greenwich's latitude is approximately 51 degrees north of the equator.

If you are a sailor it is useful to know your SpaceTime position when you are at sea and out of sight of land. Until the mid 18th century, when a clock was developed which could tell accurate time on the heaving deck of a sailing ship at sea, observing the elevation of the Sun was the only way to tell the time of day, and together with a magnetic compass work out its position and record its progress on a map. Now there is satellite navigation to fix a ship's SpaceTime position. Columbus didn't have Satnav, nor an accurate timepiece nor a map, so it is understandable that he was confused over exactly where in the world he had made landfall at the end of his epic journey. As the celebrated Native North-American musician, Buffy Sainte Marie, pertinently remarked in a 1977 T.V. interview: "October 12th 1492 was when the Native North-American people discovered Columbus". Columbus actually believed he had found a western route to India, whereas he was among the islands of the Caribbean, now known as The West Indies. In order to fix our whereabouts on Earth, we need a map reference to tell us spatially **where** we are, and a clock to tell us temporally **when**; yielding a dynamic **SpaceTime event**. Our smartphones can do that with their capability to give us a pinpoint SpaceTime event position related to a local time zone; thereafter tracing our movement is a trajectory of our SpaceTime positions (events). However that is measuring the frequency of SpaceTime events relative to the SpaceTime frequency of Earth's rotation. Clearly, intelligent beings on a different planet would measure the frequency of SpaceTime events in a way which would be local to them. But what is the frequency of Space Time Events unrelated to home-turf, when we physically or metaphysically (imaginatively) explore the cosmos? What is our best shot at identifying the objective frequency of SpaceTime events, and how does it relate to the frequency of our SpaceTime clocks? ***The universal benchmark for SpaceTime frequency is the***

speed of light, identified by James Clerk Maxwell (1831-1879) and incorporated by Einstein into his Special Theory of Relativity, published in 1905. The frequency of light, is approximately 300,000 kms per second in a vacuum, and is defined as the cosmic constant (symbol c) and the upper limit to the frequency at which SpaceTime events can be realized in the universe. That makes a second the constant frequency or tempo at which light moves 300,000 kms. But that is measuring the frequency of light relative to the frequency of our clocks calibrated to Earth's frequency. More on the speed of light later under ***Relativity and All That.***

A SpaceTime event is an instant of action in the Universal Drama, specifying where, when and the tempo at which it occurred, relative to the SpaceTime event(s) which gave rise to it (cause and effect) within a specific frame of reference. In other words, SpaceTime events specify dramatic action as it unfolds in the arena in which it is observed.

The standard analogue clock face (***Figure 3***) divides a day into two 12 hour SpaceTime periods (am and pm). A second is a period within a cycle of SpaceTime events, and if our clock ticks every second, a complete 360^0 rotation of the hour hand is a half-day SpaceTime period consisting of a trajectory of 43,200 SpaceTime events arising at one second intervals. Note that the hands on our clocks advance in tiny leaps, reflecting the discrete nature of SpaceTime events; meaning they are ***fundamentally quantized.***

Since Earth oscillates (rotates) at a constant frequency, our clocks which are analogues of Earth's rotation also oscillate at a constant frequency (constant angular velocity). That presents a challenge when we seek to measure changing frequencies (accelerating or decelerating) using our constant frequency clocks. More on this later in the section Relativity and All That.

The SpaceTime period of Earth's rotation can be divided by degrees into seconds, minutes and hours; and numbers of rotations, such as days, weeks, months, years etc. As it is, Earth's elliptical orbit and axial tilt necessitate occasional small adjustments to the annual SpaceTime period of our most precise clocks.

Our scientific understanding of objective nature is relative to the subjective nature of our minds and the instruments we use. We cannot escape the subjectivity of our observations of objective nature, and must build that reality into our rationalization of the nature of the world we live in. To personalize light, think of it as Hermes the messenger in ancient Greek mythology, wing-footing his way, bearing the latest bit of gossip between the Olympian gods by express delivery. In which case Hermes heralded Twitter (now X), by which gossip can be exchanged between mortals at lightning speed, but with arguably less enlightened content. Hermes is a good metaphor for light: the messenger carrying SpaceTime information defining the relative nature of the universal drama. That determines light as ***the cosmic clock.***

We calculate the oscillating frequency of light in seconds. But what if that is too coarse a frequency at a fundamental level? A nanosecond is one billionth of a second. So if we quantized light in nanoseconds, its constant speed would remain the same, but every particle of light (photon) would be realized as a SpaceTime event every billionth of a second, taking it closer in scale to quantum physics. Then, the cosmic clock would be seen to regulate subtle underlying levels of change.

Relating our measurements of motion (SpaceTime periods) to the frequency of light enables us to piece together a universal picture. SpaceTime events are necessarily ephemeral, with the present being just a tick of the cosmic clock. That makes the past an historical trajectory of SpaceTime events which collectively gave rise to the present; and the future is a possible trajectory of SpaceTime events yet to come, arising from the present.

So what we term a length of time is really a SpaceTime period: a trajectory of

SpaceTime events measured relative to the constant SpaceTime frequency of a clock.
The inhabitants of a planet in another galaxy would measure SpaceTime frequencies relative to the constant frequency of their own clocks, ***and intelligent life anywhere in the universe should agree on the constant SpaceTime frequency of light, viewed relative to an inertial frame of reference and measured by the constant frequency of their clocks (see Relativity and All That, later).***
We measure SpaceTime periods using clocks calibrated to the constant oscillating frequency of Earth's rotation. That may be fine for everyday measurement on Earth, but when we want to to measure SpaceTime periods of activity arising at the sub-atomic or the cosmic level, we need clocks which oscillate at appropriate frequencies. Atomic clocks are based on the oscillating frequency of electrons as they change energy levels. Caesium is an element commonly used. Like all things in the universe they are temperature sensitive, although incredibly accurate within a wide temperature range. An entry in Wikipedia tells us: "Since 1968, the International System of Units (SI) has defined the second as the duration of 9,192,631,770 cycles of radiation corresponding to the transition between two energy levels of the ground state of the caesium-133 atom". In 1997, the International Committee for Weights and Measures (CIPM) added that the preceding definition refers to a caesium atom at rest at a temperature of absolute zero. So don't let anyone sell you a cheap watch like mine!
To sum up: What we term "time" is the frequency at which SpaceTime events are realized in the universe; and our clocks are constant frequency oscillators by which we measure them. Reminder: an object's speed is the frequency of its SpaceTime realization. ***As a consequence of relativity, clocks are speedometers "ticking" relative to the SpaceTime frequency at which the clocks are realized. When the clocks are relatively at rest with Earth they are realized at the constant frequency at which Earth rotates. It is easy to measure an object's frequency of realization, using a constant frequency clock, when the object is realized at a constant frequency. However if the object is realized at a changing frequency – acceleration or deceleration – it is much more complicated, and we usually have to settle for measuring average frequencies.*** The constant SpaceTime frequency at which particles of light are realized, is the ultimate "clock" by which we measure the relative frequency of objects. Much more on this later under ***Relativity and All That***.

The Metaphysics of SpaceTime
What is reality? Reality is the realization of physical objects as trajectories of SpaceTime events. We can measure their motion within a frame of reference. For example, we can measure the motion of an object in terms of its oscillating frequency (i.e. mph). ***We use the abstract constructs of mathematics in our subjective metaphysical minds to quantify our perception of abstract constructs in the objective metaphysical mind of Nature.***

The Big Bang: In the beginning
The universe is a wholly dynamic system of SpaceTime events, and the Big Bang was the singular SpaceTime event which kickstarted the cosmic drama. Current convention proposes that the Big Bang gave rise to the universe as an expanding sphere. Continuous expansion of the universal arena would mean that the universal drama of SpaceTime events is growing further apart and structurally disordered (entropy in accordance with the second law of thermodynamics). This scenario ends with the action being too far apart to interact, even at the speed of light, and the universal drama closing with the curtain coming down on a terminally frozen scene of "heat death" (all activity is thermally driven, including ourselves). The Big Bang is given no context or

causality. It’s origin lies beyond physics and the physical; it is therefore metaphysical. ***Timely reminder: Attributing an event to a metaphysical origin is not the same as attributing it to a supernatural origin. This Inquiry seeks only to explain events which arise according to logical laws governing Nature.*** Objective metaphysics is abstract process governed by logic in the mind of Nature; whereas subjective metaphysics is abstract process, not always governed by logic and therefore not always rational, in our human minds.

NatureMind Theory proposes that the context and cause of the Big Bang is that it arose logically from the final act in the life of a previous universe, when possibilities (degrees of freedom) for future SpaceTime events were reduced to a single possibility: a new universe. Thus, the Big Bang event gave instant rise to a new field of indeterminate possibility (probability) in Nature's logical metaphysical mind, with the maximum possible degrees of freedom from which all possible universes could evolve. Simultaneously, a universal field of potential arose as the spatial domain in which possible SpaceTime events could be realized as the physical body of nature. Starting with chaotically disordered particulate events, from which structural order emerged as the degrees of freedom were reduced by logical process in Nature’s mind. This is a scenario in which the universe is created, not by an unexplained spontaneous physical event, but by a perfectly logical process governing the evolutionary lifecycle of the physical universe of our experience.

The interdependence between the metaphysical mind and the physical body of Nature gives rise to an ongoing process whereby some possibilities in Nature's mind are realized as trajectories of SpaceTime events in its physical body, whilst their mutually exclusive alternatives are eliminated. Thus, as the physical universe evolves, the field of possibility for its future evolution (degrees of freedom) reduces, converging to a singular conclusion. An analogy would be the game of chess, where the scale of the field for potential moves (physically realized as the chess board) is predetermined by the finite rules of the game, and every move reduces the possibilities (degrees of freedom) for future moves. Of course in the game of chess we have the subjective metaphysical minds of the two players mediating the process between the objective metaphysical field of possibility and the physical moves of the pieces on the board. The contraction of possibility – arising from the attritional attack-and-defend, life-and-death logic of the game – reduces the degrees of freedom, causing the dramatic action to converge into an ever-smaller area of the chess board, leading to the end-game and a logical conclusion. Stalemate is an indeterminate state of dynamic equilibrium, which is usually resolved subjectively by the players as a draw. In the case of universal chess, local states of equilibrium are resolved objectively by exogenous (outside) intervention, like the coming to rest of the spinning coin, or by what we might term unexplained random chance. Thus there is a logically progressive reduction in the field of possibility arising as disentropy towards dynamic equilibrium, which leads to clustering and bodies of ever greater density; a process leading to the creation of planets, stars and galactic systems. Eventually disentropy leads to bodymasses of such density they become "black hole" SpaceTime events. The dynamic tension of the drama resides in the deterministic-indeterminacy of fields of alternative possibility arising from the constant making and breaking of dynamic symmetries (equilibria). The determination of this tension transforms the trajectories of SpaceTime events defining the physical action of the drama. Einstein famously expressed his disbelief in the quantum interpretation of a universe based on probability, by exclaiming “God doesn’t play dice”. Well maybe God does play chess. Or maybe God is just an anthropocentric concept in the human mind, created to give teleological purpose to the existential nature of the universal drama!

In **NMT,** determinate-indeterminate possibility is finally determined through an objectively logical process, whereby all alternative possibilities are whittled down to the actual realization of a SpaceTime event. Thus applied logic is a rationalizing process towards the determination of greater structural order and a finite conclusion. As the cosmic drama approaches the endgame, disentropy leads to the density of matter and near absolute inertia of a singular black hole event and the end of the universe game; leaving just one possibility, a "Big Bang" new universe game. Therefore, **NMT** predicts a universal end which is also the dawn of a new beginning. So, instead of the orthodox description of a universe of diverging SpaceTime events in an expanding sphere of ever-increasing disorder (entropy), we have a universe of SpaceTime events systematically converging into increasing density and greater structural order (disentropy) in the body of Nature. Thus NMT proposes a universal drama, argued logically from the general to the particular, and the contraction of SpaceTime possibilities to a final state of a singular possibility. This is the precise opposite to The Second law of Thermodynamics. In other words, order (disentropy) logically prevails, not entropy (disorder).
The Big Bang raised the curtain with the maximum degrees of freedom for action in the Universal Drama to evolve, some of which are realized as the drama unfolds, with the curtain predicted to fall leaving just one possibility: all possible degrees of freedom for a totally new Universal Drama. Starting with the Big Bang, we can say that exogenous force drives objects into disequilibrium, whilst reactive force draws them together into equilibrium. It is the dynamic interplay between active and reactive forces which define the evolution of the universal drama.
To sum up, logically the universal drama commensed with a field of possibility for all possible universal dramas to ensue, thereafter reducing by attrition until there is just one possibility left, the end of the current universal drama, and the Big Bang beginning of a new one. ***That, of course, is the exact opposite of the current conventional hypothesis.***

Gravitation: **The dynamic tendency towards equilibrium**
Gravitation isn't just about what happens when an expensive bottle of wine slips from your grasp. To quote Wikipedia: ***Gravity (from* Latin *gravitas 'weight'), or gravitation, is a* natural phenomenon *by which all things with* mass *or energy – including* planets, stars, galaxies, *and even light – are attracted to (or gravitate toward) one another.* On Earth, *gravity gives* weight *to* physical objects, *and the* Moon's gravity *causes the* tides *of the oceans. The gravitational attraction of the original gaseous matter present in the* Universe *caused it to begin* coalescing *and* forming stars *and caused the stars to group together into galaxies, so gravity is responsible for many of the large-scale structures in the Universe. Gravity has an indefinite range, although its effects become weaker as objects get further away.*** Such a description would cause any physicist or philosopher to ponder the mysterious nature of this ubiquitous phenomenon; surely the greatest question in physics and metaphysics, since gravity addresses the manner in which matter is formed and how the universe got together. It simultaneously addresses the existential question of how did we become.
Wikipedia: *Newton's law of universal gravitation is usually stated as that every* **particle** *attracts every other particle in the universe with a* **force** *that is* **directly proportional** *to the product of their masses and* **inversely proportional** *to the square of the distance between their centers. The publication of the theory has become known as the "***first great unification***", as it marked the unification of the previously described phenomena of gravity on Earth with known astronomical behaviors. This is a general* **physical law** *derived from* **empirical observations** *by what* **Newton** *called inductive reasoning* (arguing from particular evidence to reach a general conclusion). *It is a part of* **classical mechanics** *and was formulated in Newton's work* **Philosophiæ Naturalis Principia Mathematica** *("the Principia"), first published on 5 July 1687.*
In today's language, the law states that every **point mass** *attracts every other point mass by a* **force** *acting along the* **line** *intersecting the two points. The force is* **proportional** *to the* **product** *of the two*

masses, and inversely proportional to the **square** *of the distance between them.*
The first test of Newton's theory of gravitation between masses in the laboratory was the Cavendish experiment conducted by the British scientist Henry Cavendish in 1798. It took place 111 years after the publication of Newton's Principia and approximately 71 years after his death.
Newton's gravity implies motion, whilst lacking a relative metric to describe it. Adding such a metric transforms the stasis of an attractive force between two objects, and the distance between them into two SpaceTime events; with motion between them being a trajectory of SpaceTime events. If Nature's SpaceTime metric is calibrated in nanoseconds (one billionth of a second) a SpaceTime event is realized every billionth of a second, which would account for why we perceive motion as a continuity rather than the trajectory of discrete SpaceTime events it really is. Adding direction to the gravitational attraction between two objects, confirms the observation that the less massive object is more strongly attracted towards the more massive one, confirming that the strength of an object's gravitational attraction is proportional to its mass.
Newton says the force of gravity between two objects grows stronger the closer they become, so an object attracted to Earth should accelerate right up to the instant it lands. ***However, the object ceases to accelerate if it reaches "terminal velocity", so it would seem more appropriate to refer to it as terminal acceleration*.**
So Newtonian gravity ceases to be a force beyond the point of terminal acceleration, but of course the object continues to "fall" towards Earth at constant velocity. This raises the question of whether gravity is a force at all, a question which is addressed by Einstein in his General Theory of Relativity.
Einstein's theory of gravity eliminates force from the effect that an object with larger mass has on the motion of an object with lesser mass. In his theory space is perceived as four dimensional ***spacetime*** which becomes curved by the more massive object, causing a passing less-massive object – including a massless photon – to move towards it. This can be visualized in three dimensions as being rather like placing a heavy weight in the centre of a trampoline causing its surface to curve. If we then place a relatively lightweight tennis ball at the edge of the trampoline it will roll inwards towards the heavier weight. If we gently roll the tennis ball along the edge of the trampoline, it will adopt a curved trajectory towards the heavier weight. If we roll the tennis ball with sufficient force, it will escape the trampoline altogether, with just a slight deflection towards the heavier weight along the way. So according to Einstein, the less massive object travels towards the more massive object following the curvature of spacetime. Actually both objects would curve spacetime, but the more massive one would curve it more, causing the lesser one to move towards it. ***Of course Einstein's theory essentially depends upon the reality of four dimensional spacetime.***
4D spacetime consists of the orthodox rectangular three spatial dimensions, plus time as a fourth dimension. It was devised by Hermann Minkowski, (1864-1909) one-time maths tutor to Einstein. ***However, as will be shown later in a critique of Minkowski 4D spacetime, time as a fourth dimension is conceptually invalid – motion is only possible in both space and time, described in this inquiry as three dimensional SpaceTime. So, although time travel makes for good fiction, it is not possible in reality.*** Nevertheless, empirical evidence points to a high degree of accuracy when Einstein's theory is applied to the deflection of massless particles of light from distant galaxies as they pass objects with large mass such as our Sun. According to Newton's theory massless particles would not be subject to gravitational force. Einstein's theory resolves that anomaly. Despite its shortcomings Newton's theory has provided astrophysics with a working model of the mechanics of the solar system governing the motion of the planets orbiting Sun. And applied here on Earth, there is over 300 years

of evidence that structures using his theory remain firmly on their feet, and plumb-lines descend vertically anywhere in the world. That is because we and the structures we build are at rest relative to the terra firma on which we both stand relatively motionless. However, ***Relativity*** kicks in when we and the objects we observe are in significant relative motion.
A massless photon under Newton's theory should not be influenced by the gravitational attraction of a massive body, such as a star. However, under Einstein's theory a passing photon would undergo a slight deflection before its phenomenal speed enabled it to escape the curvature of spacetime caused by the massive body.

So, Newton and Einstein both have evidential support, while neither is entirely conclusive. **So what then is the nature of gravity?**
We have just described how the Big Bang event gave rise to a field of possibility for all possible universes to arise, and how those possibilities have been systematically reduced by attritional action towards a future singular SpaceTime event and the end of the universal drama. This ineluctable movement from disorder towards greater order can be defined as **universal gravitation**. It is the exact opposite of the conventional proposition that things move from order to disorder (entropy). It is clear then that SpaceTime events are nessarily gravitating towards each other and an end of SpaceTime black hole event. That journey is patterned with periods of making and breaking of dynamic equilibrium, aka objects.

Relativity and All-That
This section contains references to an observer. The objective universe does not require a subjective observer to interact with and validate it. The universe would still exist, in the abstract logical laws of its metaphysical mind and the reality of its physical body, if our species became extinct – which is a distinct possibility. However, our perception of the objective universe we live in is necessarily relative to us the subjective observer. So in that sense, relativity is our subjective perception of the reality we perceive. Relativity tells us that everything is relative to everything else, in which case everything in the universe is relative to each and every one of us. Sigmund Freud would agree that we are egocentric in our metaphysical mind, now it can be stated that relativity makes us physically centre stage in the universal drama. So let's set aside our egos and accept that although we are the centre of our universe, so is everyone else the centre of their universe. You could call that cosmic democracy! ***In general terms, the centre of the universe is from wherever it is surveyed***. That has serious physical and philosophical consequences.
We are used to perceiving dimensions in absolute terms: timeless and unchanging. If it were not so, measuring-up for curtains would be a frustrating experience. However, Einstein's Special Relativity posits a universe which is wholely dynamic, where absolute measurements of space (using measuring rods), time (using clocks) or speed of movement (using speedometers) are not possible.
As we saw with the earlier example of an object moving within the cycle of a rotating disc, the speed at which it moves is the SpaceTime frequency at which it oscillates. In general, the speed at which an object moves is the oscillating frequency of a SpaceTime cycle (e.g. metres per second). The intrinsic curvature of "straight lines" on Earth is defined by the term ***Geodesics***. In Einstein's General Theory of Relativity, space is an undetectable physical medium termed "spacetime" which is curved by gravity, causing objects moving in it to follow curved paths. In ***NMT***, space is an abstract field of potential in which SpaceTime events are realized as curved trajectories due to the systemically finite nature of the universe. Thus affirming that all objects

move in cycles, including photons of light. So the notion that the shortest journey between any two points is movement in a straight line is a fallacy, since motion is intrinsically cyclical. ***Crucially, we must add the logical maxim that motion arises as a process of cause-and-effect action, so it always points to the future. That means that every object in the universe, whatever relative direction it is moving, is always moving towards the future.*** For example, two objects heading towards each other, are heading in opposite directions whilst simultaneously heading towards the future, and a possible future collision. So when we see light from a distant galaxy, which has taken billions of light-years to reach us, we are not literally looking back into the past. Logically, what we see is the present end of a trajectory of SpaceTime light-events originating in the distant past. Archaeologists do not uncover and reveal the past, they uncover and reveal present evidence of past events, and ponder their meaning. So pondering universal evidence means we have to comprehend the logic of cause-and-effect which gives rise to the relative events we perceive.

As set out earlier, we measure frequencies using the constant oscillating frequency of clocks we have constructed, or by noting the constant oscillating frequency of the trajectory of the sun across the sky during daylight, or stars across the night sky. All of which are fundamentally oscillating relative to the oscillating frequency of light (electro-magnetic radiation). Visible “white light” can be refracted by a medium, such as falling rain or a prism, into a spectrum of different frequencies from red to violet (rainbow colours). The non-visible (to us) spectrum includes infrared and ultraviolet. ***So electromagnetic radiation oscillates over a spectrum of frequencies (speeds) of which visible “white light” is but one.***

Movement between two places is conventionally perceived in terms of the ratio between space and time: a spatial period (what is the measured distance) / a temporal period (how long by clock time did it take), yielding a SpaceTime frequency (average speed). So, in a dynamic universe, space and time do not exist as separate entities, but as unified SpaceTime. As we saw in the earlier example of the rotating disc, motion is a trajectory of SpaceTime events; and clock time by which we measure it is a trajectory of SpaceTime events. All SpaceTime events are holistically related to all other SpaceTime events in the universe, hence relativity. Amidst all that complexity, we can only perceive universal motion as statistical patterns of SpaceTime events, or seek to identify significant SpaceTime events relative to specific cause-and-effect trajectories of SpaceTime events.

Objects on Earth oscillate relative to Earth, which oscillates relative to Sun etc. etc. So all are oscillating within relative cycles. It is quite common to refer to our body-clock with regard to its periodic self-regulation. We all embody systemic biological SpaceTime oscillators, some oscillating faster than others. Even when we die our remains oscillate in cycles as they decay, and the matter they decay into oscillates in a universal system of cycles, be they classified as organic or inorganic. So all phenomena oscillate – relativity rules out absolute inertia, including “absolute zero temperature”. Instruments measure quantities through equilibrial metrics – high frequency oscillation between values, just like weighing scales and balances. Therefore absolute zero would be unmeasurable, even if it existed. So the term absolute zero must be nominal not absolute.

To restate relativity: All phenomena intrinsically oscillate relative to all other phenomena, with fundamental particles, including photons of visible light, oscillating at the greatest frequencies of all, with their wavelengths being the shortest possible periods. So there is no possible state of absolute inertia.

Setting aside continental drift taking place in geological SpaceTime, the distances between locations on the surface of Earth are constant values. That is to say, points

A and **B** are “at rest” relative to Earth and to each other, and the spatial distance between them remains constant. Therefore, if they are within the same SpaceTime zone, clocks at **A** and **B** will show the same SpaceTime period, with no difference between them. A watch on the wrist of a traveler riding on a train from **A** to **B** will also show the same SpaceTime period as the two clocks. However the traveler is not at rest relative to **A** and **B**, but is in motion relative to them; hence the frequency of travel. If the traveler's watch were synchronized to the frequency of the train it would tick at the same rate as the station clock before it left **A** because it was then at rest with Earth, and the tick of the watch and the station clock would both relate to the frequency of Earth’s axial rotation. The acceleration of the train at the beginning of the journey is a period when the SpaceTime frequency of the watch would increase; and the deceleration of the train at the end of the journey is a period when the SpaceTime frequency of the watch would decrease again. So, although ticking at varying frequencies, the traveler's watch would overall tick faster than the station clocks, consequently a difference in SpaceTime periods would have arisen between them. So the traveler, comparing the watch with the station clock on arrival at point **B**, would conclude either that the clock was “slow” or the watch was “fast”. However the watch and the clocks would now be at rest relative to each other, so whilst showing different SpaceTime periods they would now be ticking at the same tempo.

Clearly, in a universe in which everything is in relative motion, clocks are the speedometers of that relative motion. But not to bother, difference in SpaceTime periods relative to speed of travel is insignificant for normal journeys on Earth, so you and your date will be in perfect SpaceTime harmony to meet together under the station clock at point **B.** However, if your date is with an extra-terrestrial on a distant planet, you had better carefully work out the relative SpaceTime period of your journey. Remember the period of your life cycle is determined by the tempo at which your body clock ticks, which in turn is relative to the speed at which you travel. So the tempo at which your body clock ticks before take-off is related to the frequency at which Earth rotates on its axis. Let us assume that your date's planet is the same size and is rotating at identical frequency to Earth; so while you remain on Earth you are both ageing at the same rate. However, the instant you take-off your body clock will accelerate in synchrony with your spaceship’s embodied oscillator (speedometer) until it reaches cruise speed. As you approach your destination, your spaceship, along with your body clock, will decelerate until you land, at which instant your body clock and that of your date should again be ticking at the same rate. However, your body clock will have ticked faster than that of your date throughout the SpaceTime period of your journey, and the lifetime period of your body clock may well have expired, and your ticker stopped before you reach your destination. So unless your date is into necrophilia, it’s best to date beings who are more local to you. To keep romance alive, we could put space travelers into an induced state of hibernation (suspended-animation) to slow their body clocks down relative to their spaceship’s embodied oscillator, during hyper-fast journeys. ***As will be shown later, a spaceship’s weight will increase in opposition to an accelerating force, so as to strictly limit the velocity to which it can be accelerated. Therefore, the frequency of the embodied clocks of its occupants will not be fast enough to age them significantly relative to clocks synchronised to Earth time***.

The universe is wholly dynamic, with everything from the smallest particle to the largest body oscillating at frequencies relative to the Cosmic Clock. The complex oscillating trajectories of SpaceTime events which make up the physical body of the universe, define who we are and our place in the universal drama. That has an interesting consequence. The question may be asked: If the "Big Bang" gave rise to a concentrically expanding universe, as cosmological orthodoxy decrees, there should be

a SpaceTime point of origin, and if so, where is it? That question was answered a little earlier: The relative centre of the universe is ***here*** and ***now*** for every observer. Counter intuitive relativity?
The structure of an object, realized instant-by-instant, is fundamentally a dynamic pattern composed of oscillating particulate SpaceTime events. So the tumbling trajectory of a giant asteroid is fundamentally an instant-by-instant changing pattern of particulate SpaceTime events. If we trace the trajectory of a cricket ball when it is hit for six, the ball is realized in its flight every tick of the Cosmic Clock as a unique SpaceTime event. So what we perceive as a ball in flight is the trajectory of its distinctive pattern of SpaceTime events. A trajectory of SpaceTime events can be described by a concatenated (joined together) stream of vectors; described as point vectors with their length being restricted to the length of their SpaceTime event. That means the vectors are instances of linearity in a fundamentally non-linear universe.
The constantly changing particulate pattern of SpaceTime events reflects the intrinsic discrete nature of matter, be it solid, liquid, gas, plasma or some other quantum state.
A vector can describe the direction and distance between two locations **A→B** on a map. A geographical map is a two dimensioned (flat) representation of Earthly terrain, whereas Earth is a sphere in three dimensions. So for direction and distance to be meaningful to the traveler, a single vector needs to sum up the trajectories of the many vectors along the way which take account of features such as contours, diversions and the curvature of Earth's surface. A trajectory all the way around Earth's spherical form is a negative (downward) curve known as a Great Circle. If the trajectory takes place above the surface of Earth by a circumnavigating aircraft or an orbiting satellite, its journey will be curved by Earth's gravity. But if we journey on Earth's surface, our journey is also curved by Earth's gravity. A flat surface is a 2-dimensional "Euclidean" space, while Earth's surface is a 3-dimensional space. So fundamentally there is no such thing on Earth as an absolutely level playing field, and politicians should seek another metaphor.
Knowing distance and direction is only of limited value if you are planning a journey; you will want to estimate the journey's complete SpaceTime period, so you know ***when*** you will arrive at your ***where*** destination. That is done by estimating the SpaceTime period for the journey according to a speedometer clock.
A SpaceTime period is a trajectory of SpaceTime events describing the motion of an object. So a SpaceTime period describing an object moving a linear distance **A→B** will be the average of a non-linear trajectory of SpaceTime events.
Motion relative to us, literally changes everything in our subjective perception of objective reality. Motion transforms a spatial distance into a SpaceTime period, and a spatial location into the activity of a SpaceTime event.
If we stand on the platform of a railway station and observe a train waiting at the opposite platform, we will gain an unchanging visual image of the pattern of the train. That is because we are at rest with the train, and the light carrying the constant stream of images of the train is gathered by the retinal receptors in our eyes and communicated neurologically to our brain as a constant pattern of events. If the train starts to move relative to us, that constant pattern of events is transformed into a dynamically asymmetric pattern. Although the pattern continues to reach us at the speed of light, the distance and direction from us is continually changing due to the motion of the train. That means the SpaceTime period for the images to reach us is also continually changing, so the pattern of the previously stationary train relative to us begins to distort along the direction of motion. This dynamically asymmetric transformation is very much greater if it is of a non-stop express train whizzing past the opposite platform.

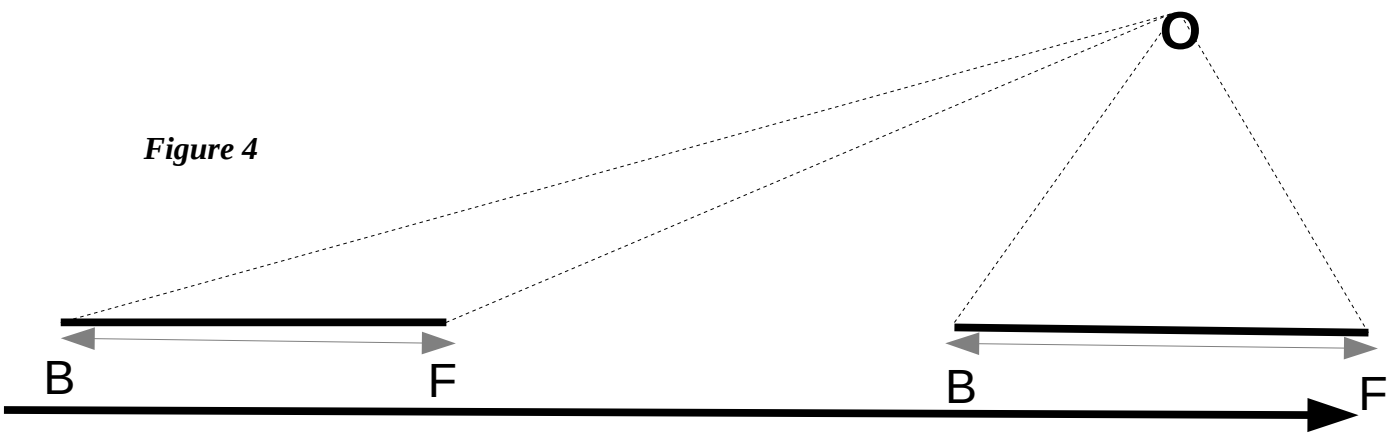
If an express train whizzes past our platform, the closeness of the train further increases the visual effect to a dynamically asymmetric blur. In addition to which the displaced air gives us a buffeting. So an observer's visual perception of an object at any instant is determined by the SpaceTime period of light between them. Therefore an observer standing in the path of an approaching express train will receive visual information of the train with increasing frequency as the train grows closer and the SpaceTime period of light between them grows shorter. The observer's brain will process whether the image of the train is increasing or decreasing in scale, and therefore whether the train is approaching, stationary or receding. Also, the received frequency (pitch) of the warning horn of the train will increase or decrease depending upon whether it is approaching or receding: ***the Doppler effect***. From the perspective of the hearing observer, the SpaceTime frequency of the horn signal relates to the movement of the train: constant when the train is stationary, increasing as the train approaches, and decreasing as the train recedes. Fortunately, visual information carried at the speed of light greatly exceeds the speed of any train. Nevertheless, dear observer, please don't try for a dramatic last second selfie before dodging out of the way, or you may experience at first hand the drastic impact of a relatively large and weighty, rapidly moving object!
When we describe motion in everyday local terms we usually imply motion relative to Terra Firma (the ground on which we stand). The previous description of the train, was of its motion relative to an observer standing motionless on Terra Firma.
Scientific observers are human, and their instruments are human-made, so scientific observations (including measurements) are intrinsically subjective, no matter how objective the scientists attempt to be. Moreover, subjective observations are relative to the limitations of the frame of reference in which we view them, so we never get to see "the whole picture". On the other hand, scientists seek quasi-objectivity by identifying and employing universally invariant parameters by which to describe objects in motion. One such parameter is the frequency of light.
If we wait for a bus, we are stationary relative to the ground we stand on, whilst our watch ticks away at a constant frequency. Therefore standing still is a SpaceTime period of dynamic symmetry, oscillating between possible asymmetric directional movement, while the clock continues to tick. However, in cosmic terms, we are only relatively stationary: the Earth on which we are standing is in motion as it rotates on its axis relative to Sun etc. And the Cosmic Clock is still pacing out the fastest tempo of universal SpaceTime motion at the frequency of light. So when we wait for a bus, we are motionless relative to Earth, whilst in cosmic terms we are a trajectory of SpaceTime events, moving relative to **c** the light-speed of The Cosmic Clock.

Einstein's Special Relativity refers to the ***special*** case where objects are in motion relative to "*inertial*" frames of reference (neither accelerating nor decelerating).
As a result of Relativity, periods of space and time can no longer be treated as invariant or separate. They are SpaceTime periods which depend upon the speed at which they arise relative to the frame of reference in which they are observed. So the kinematic (moving) proportions of what you see from a train window, depend upon the velocity of the train relative to the earth over which it travels. The faster the train, the less definitive are the scale of what you see outside the window.
Lorentz Contraction (Nobel Laureate, Hendrik Lorentz 1853-1928) relates the length of an object to the inverse of its velocity – the faster it moves, the shorter its length becomes along its direction of travel. This phenomenon was further elaborated by Einstein in his Theory of Special Relativity.
As we saw with the earlier example of an object moving within the cycle of a rotating disc, the faster it moves (systematically oscillates) the shorter its wave length. So an

object moving at the speed of light would have the shortest possible wavelength, such as a light particle (photon). ***However, all motion is relative to a point of reference.***

In ***Figure 4*** an object approaches, then becomes adjacent to an observer **O**.
It can be seen that as the object approaches **O**, the SpaceTime period for light to travel from the back of the object **B** is longer than the SpaceTime period from the front **F**, which is a measure of the length of the object relative to **O.** The instant the object becomes adjacent to **O**, they are relatively at rest, neither moving closer nor apart, and the SpaceTime periods for light to travel from the front and from the back of the object are equal in length. As the object recedes from **O** (not illustrated) the SpaceTime period for light to travel from its front is greater than the SpaceTime period from its back, therefore the length of the object relative to **O** increases. So, in general, the length of an object relative to an observer becomes shorter as it approaches, and longer as it recedes; the faster the relative motion, the quicker the transformation in length becomes.
Of course, if the object was directly approaching or directly receding from the observer, the observer would only see one end of the object, so would have no perception of its length. NB. If the observer were a passenger on board the object, its length would remain constant, because the passenger and the object would be relatively at rest to each other.

Figure 4



Time Dilation was a concept introduced by Einstein in Special Relativity, proposing that time on board a moving object slows down the faster the object moves. A symbol **γ** (gamma) was assigned to the quantification of the phenomenon.

Figure 4a

In ***Figure 4a***, an object faces an observer (**O**). A clock on board the object emits a light signal towards the observer as it ticks every second. If the object and **O** are at rest relative to each other, the frequency of the light signals relative to **O** will remain once every second. However, if the object approaches **O** at a constant speed, the frequency

of the light signals will accelerate as the SpaceTime period for them to travel reduces at an accelerating rate (constant distance reduction accelerates the rate of reduction). Conversely, the frequency of the light signals decelerates as the object recedes from **O** (not illustrated) and the SpaceTime period for them to travel increases at a decelerating rate (constant distance increase decelerates the rate of increase). In general, the frequency at which an object appears to move relative to an observer, accelerates or decelerates, depending upon whether the object is approaching or receding, and the speed at which it does so.
Sound is fundamentally particulate oscillation, and if the moving object emits a constant frequency sound, its frequency relative to **O** accelerates, or decelerates, depending upon whether the object is approaching or receding and the speed at which it does so – ***the Doppler Effect***. We have just seen that the Doppler Effect applies equally to light.
If the light signal was a pattern of light events reflecting the image of the object, it would be constant if the object and **O** were relatively at rest. However, it would grow larger at an accelerating rate if the object was approaching, or smaller at a decelerating rate if the object was receding. So, if you are a freefall parachutist, the earth will appear to be rushing towards you at an increasing rate, even if your rate of descent has ceased to accelerate. Better carefully observe your altimeter and deploy the parachute at the correct moment and slow down your heart rate as well as your descent! Incidentally, the term freefall is misleading: the parachutist descends to earth at an accelerating rate until the rate of descent reaches ***terminal acceleration***, when the increasing rate of the parachutist equals the rate of gravity. Only if and then is the parachutist in constant velocity weightless freefall. Weight returns as momentum when the parachutist hits the ground. Hopefully the parachute has deployed by then! (* See later).

Light is part of the frequency spectrum of electro-magnetic radiation. Visible light covers the spectrum from red to violet (rainbow colours) with white light being the integration of all the visible frequencies. Remind ourselves that oscillation is a cycle of SpaceTime events, and all matter oscillate forming SpaceTime waves. Visible events are fundamentally modulations of light waves, in the same way that radio signals are modulations of radio frequency “carrier waves” (i.e. messages carried by electro-magnetic waves). That means light gives rise to all visible SpaceTime events. So when we see a car approaching us, our perception of its speed is the varying frequency of its modulated light wave reflection, not the constant frequency of the carrier light wave. The scale of the modulated wave being relative to the scale of the car in this instance (a bus, of course, having a larger scale wave).
Variation in the frequency at which a light borne image is received is crucial. When the frequency of light images emitted by far distant galaxies was perceived to be moving towards the red end of the colour spectrum (Red-Shift), it was theorised that the universe must be expanding, thus stretching and slowing the frequency at which the images were received. If distant galaxies are receding relative to an observer at a constant speed (not subject to an accelerating force), their observed frequency will decrease at a decelerating rate (red-shift at a decreasing rate) as set out above. However, the intrinsic cyclical (oscillating) nature of universal motion would imply that the distant galaxies were receding on a curved trajectory, and not a consequence of a universe which is infinitely expanding outwards. The expanding universe hypothesis has raised the difficulty of there being insufficient known matter and energy to support its mechanics; hence, hidden dark matter and energy have been hypothesised. In other words, there is the assumption that the missing matter and energy are there, but we just can’t detect it. NMT obviates the need for dark matter and energy. However, it can be

logically implied from the above that electromagnetic waves, other than those at visible frequencies – specifically ultra violet – might give rise to events which would not be possible by causation transmitted at the speed of visible light. ***What Einstein called "spooky action at a distance". So it might be possible for matter to move faster than the speed of light (c).***

Since all things are in relative motion, temporal periods and spatial periods are intrinsically inseparable as SpaceTime periods. This becomes clear if we treat every event as an interdependent SpaceTime event, and all motion as trajectories of SpaceTime events, as has been the practice in this Inquiry. So if we look again at ***Figure 4a***, the movement of light between the object and **O**, are trajectories of SpaceTime events. ***Motion is intrinsically SpaceTime oscillation which can be described as the length and frequency of sine waves. Hence the historical debate over whether light is particulate or wavelike – leading to Neils Bohr's Copenhagen Interpretation, that whether light is perceived as wavelike or particulate, depends upon the nature of the experiment.*** An observer who is midway between two light events, will see them as simultaneous and equal distance away (a) if all three are relatively at rest, or (b) if the emitters are simultaneously moving either towards or away from the observer at the same speed; since light carrying the images to the observer will then have similar SpaceTime periods.

As for "time dilation", a clock on board a moving object is, as set out earlier, actually a speedometer,. So clock time on the object is synchronized to the relative speed at which the object moves, which in cosmic terms is relative to the speed of light.

The question may be asked whether counter-intuitive Relativity is illusory or real. Well Relativity makes clear that what is "real" depends upon – well relativity!

Back down to Terra Firma, if an athlete remains stationary on the start line of a hundred metres running track, the race timer's stopwatch will not have started, so both the runner and race-time are at rest relative to the track. But in terms of the clock on the pavilion roof, seconds are ticking away because the clock is an analogue of the SpaceTime period of Earth's rotation which never stops. Earth rotates at a SpaceTime frequency of 460 metres per second, so if the athlete and SpaceTime on the official stopwatch remain stationary for 10 seconds by the pavilion clock, Earth will have rotated a distance of 10×460 = 4,600 metres. If the athlete runs the hundred metres in 10 seconds, a very respectable time for a male of our species, his average SpaceTime frequency will be 10 metres per second. But that is to judge the athlete's performance relative to Earth's clock. How would an athlete's performance be relative to the SpaceTime frequency of light, the cosmic clock? Of course the athlete would be phenomenally slow (ten metres traveled every second, compared with 300,000 kilometres traveled every second). The race officials would then have to wrestle with relativity before announcing the performance result. It is reasonable to ask, just what is the relevance of measuring the performance of an athlete relative to the speed of light? Usain Bolt was known as Lightning Bolt, but no one thought that he was quite that quick! And relative to light Usain was a bit slow, although quite a bit quicker than the rest of us. We can happily measure motion on Earth for most purposes without concern for the complexities of relativity, but when it comes to a fundamental understanding of universal motion, relativity to the frequency of the Cosmic Clock (**c**) is vital.

A second is rather a long SpaceTime period for precise measurement in the scientific world, where atomic clocks oscillate at phenomenal frequencies. To quote *LiveSci=nce*:

Scientists have measured the shortest unit of time ever: the time it takes a light particle to cross a hydrogen molecule. That time, for the record, is 247 zeptoseconds. A zeptosecond is a trillionth of a billionth of a second, or a decimal point followed by 20 zeroes and a 1. Previously, researchers had dipped into the realm of zeptoseconds; in 2016, researchers reporting in the journal Nature Physics used lasers to measure time in increments down to 850 zeptoseconds. This accuracy is a huge leap from the 1999 Nobel Prize-winning work that first measured time in femtoseconds, which are millionths of a billionths of seconds. It takes femtoseconds for chemical bonds to break and form, but it takes zeptoseconds for light to travel across a single hydrogen molecule (H2). To measure this very short trip, physicist Reinhard Dörner of Goethe University in Germany and his colleagues shot X-rays from the PETRA III at Deutsches Elektronen-Synchrotron (DESY), a particle accelerator in Hamburg.

Note that what is referred to as a unit of time is actually a SpaceTime period, as set out earlier.

Minkowski Spacetime

"The views of space and time which I wish to put before you have sprung from the soil of experimental physics, and therein lies their strength, they are radical. Henceforth space by itself and time by itself, are doomed to fade away into mere shadows, and only a kind of union of the two will presume an independent reality".
Hermann Minkowski, 1908.

Three years after Einstein introduced Special Relativity, in which the speed of light is the determinant factor, Minkowski sought to create a universal frame of reference by transforming 3 dimensional space into 4 dimensional spacetime, a cosmic domain in which the properties of objects are invariant. To do this Minkowski takes the geometry of a spatial dimension – in principle it could be all three, but we can't illustrate four dimensions, not even using computer generated graphics – to which he adds time as a perpendicular fourth dimension. Within this structure, distance **s** in ***4D spacetime*** is created geometrically from (a) a spatial period and (b) a temporal period. The spatial period is measured relative to some form of measuring rod, whilst the temporal period is measured relative to a clock. To enable the geometry the temporal period is given a distance by relating it to the speed of light. For example, the distance to stars and galaxies is measured in light-years – a light-year being the distance traveled in one Earth-year moving at **c** the constant speed of light. ***So in effect, speed and distance in time is equated with speed and distance in light.*** And in the calculation of 4D spacetime, a distance in time is derived from **ct**, the product of the speed of light **c**, and **t** the clock time elapsed traveling the spatial distance **x.** Therefore, if **c** is in metres per second and **t** is in seconds, **ct** is a distance traveled at the speed of light in **t** seconds. So if an athlete stands motionless at the start-line of a hundred metres running track for 10 seconds measured by our watch, time at the speed of light will have traveled away a period of 10 seconds x 300,000 kilometres per second = 3 million kilometres. If the athlete actually runs the 100 metres during the 10 seconds – a respectable time for a male of our species – he will have physically moved a distance of 100 metres whilst time will have traveled 3 million kilometres away from him. In which case his 4D spacetime distance traveled **s**, is calculated in both space and time. In the case of the athlete running 100 metres, we use the horizontal spatial dimension.

It is useful to describe 4D spacetime in general terms using simple algebraic notation. In ***Figure 5***, **Event A** gives rise to **x** a spatial distance traveled by object **X** during a time period **t,** and ending at **Event B**, whilst **ct** is the calculated distance that time traveled away from **X** at the speed of light during the time period **t** that **X** is moving the spatial distance **x;** while **s** is the invariant distance in 4D spacetime we seek to calculate from values for **x** and **ct.** ***Note: spatial distance (x) and temporal distance (ct) are treated as separate entities, prior to their merger as spacetime (s).***

Given that we have a right-angle triangle, and the distance we seek is the longest side of the triangle (the hypotenuse) we might expect to calculate **s** using Pythagoras' theorem, known to all schoolkids as "The square of the hypotenuse of a right-angle triangle is equal to the sum of the squares of the other two sides". In which case $s^2 = (ct)^2 + x^2$. However under Minkowski this is rejected, since it is argued that under rotation the distance **s** could point in any direction, including backward in time which would violate the temporal rule of cause-and-effect. So $s^2 = (ct)^2 - x^2$ is chosen as the only available alternative. This is the formula which leads to ***hyperbolic space***, so that **s** departs from the plane space of Euclid (flat surfaces) to a negatively curved surface (the exterior surface of a sphere is negatively curved surface). Invariance means that the distance **s** is constant, even when measured by different observers traveling at different

velocities. The argument here, is that in 4D spacetime all objects move at the invariant speed of light. In which case our athlete is moving at the speed of light in 4D spacetime, even when he is standing still on Earth.

Figure 5

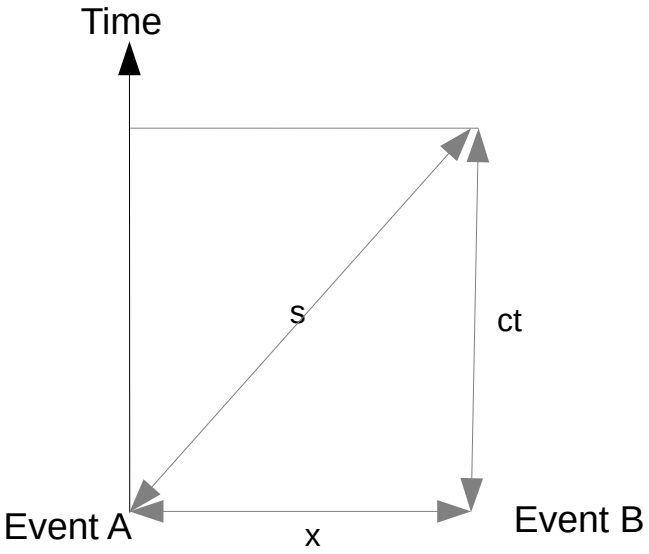
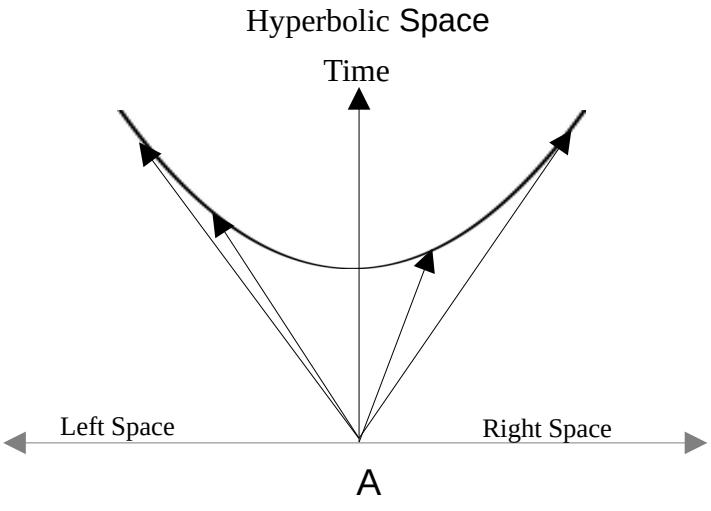


Figure 6 shows a sample of different vectors representing the invariant 4D spacetime distance (**s**) between Event **A** and Event **B** in hyperbolic space, as calculated by different observers who view the motion of object **X** subjectively in different relative frames of reference, namely through moving at different relative velocities. The vectors shown, although different in flat Euclidean space, are invariant trajectories in curved hyperbolic space. This is demonstrated by them all ending at a curve, known as a hyperbola, which represents their invariant spacetime length. Remember we're now in negatively curved space, not the flat Euclidean space with which we are familiar, so the characteristics of hyperbolic space are bound to seem counter-intuitive.

Minkowski spacetime vectors, all representing the same distance in four dimensional Hyperbolic space

Figure 6



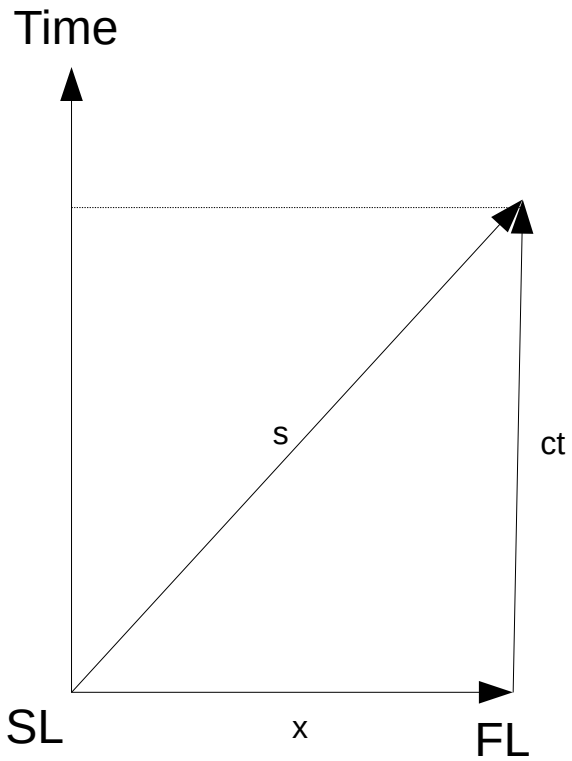
Critique of Minkowski 4D Spacetime

The first thing to say is that Minkowski Spacetime is conceptually flawed.

Let's analyze it step-by-step to show why. Firstly, the lengths of each of the three sides of the triangle are distances traveled, initiated by **Event A**, so they should indicate the cause-and-effect direction of travel as well as the distance traveled. That is to say each of the three sides should be shown as vectors. ***Crucially, the vectors all point towards the future.*** This is best illustrated if we return to the example of the athlete running the 100 metres in 10 seconds.

In ***Figure 7***, **SL** and **FL** are the start and finish lines; **x** is the 100 metres distance run; **ct** is the distance that time traveled away from the athlete at the speed of light during the 10 seconds taken to run the 100 metres; and **s** is the calculated invariant spacetime distance in hyperbolic space that the athlete has traveled during the 10 seconds.

(NB. **s** shown here as a straight line in *flat* two dimensional Euclidean space, due to the modification of Pythagoras' Theorem is a negatively curved distance in hyperbolic space).



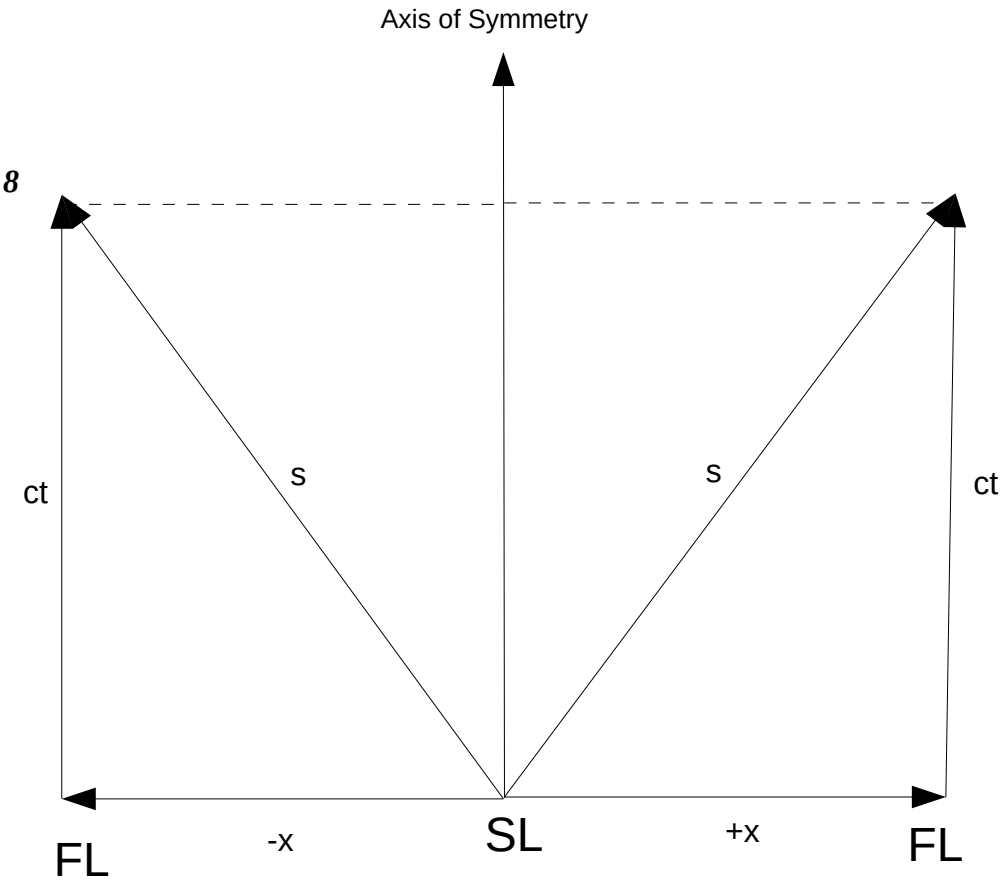
Now we turn to the modification of Pythagoras' theorem, so that the square of its spatial dimension is deducted i.e. $s^2 = (ct)^2 - x^2$.

Figure 7 shows **x** as a distance moved to the right. But that is only one half of the possible movement in the spatial dimension. The full geometry of possibility needs to include movement to the left (equivalent to running right-to-left). That is to say possible movement is bilaterally symmetrical, left or right from the point of origin (the start line in our athletics example).

Figure 8 shows a symmetrical structure with the vertical **SL** vector as the axis of symmetry. The symmetry allows equal possibility for spatial movement to point right or left from **SL**. So using our conventional system of designating integers pointing right from a point of origin as positive numbers, and those pointing left as negative numbers, we have positive or negative values of **x**. The squares of negative or positive numbers (e.g. $-\mathbf{x}^2$ or $+\mathbf{x}^2$) have the same value, with the difference being that they are on opposite sides of **SL** the axis of symmetry, thus determining whether **s** points to the "North East" or to the "North West" of SL. Reference is made to "**Making Sense of Direction**"

earlier in this Inquiry, regarding the right-handed directional bias in our orthodox system of assigning plus or minus to integer values. If we use the ***NMT Symmetrical Numbers System*** to indicate direction: Lx is spatial motion to the left, and Rx is spatial motion to the right; and the spacetime equation using ***unmodified Pythagoras theorem*** is either $s^2 = (ct)^2 + Lx^2$, or $s^2 = (ct)^2 + Rx^2$.

Figure 8



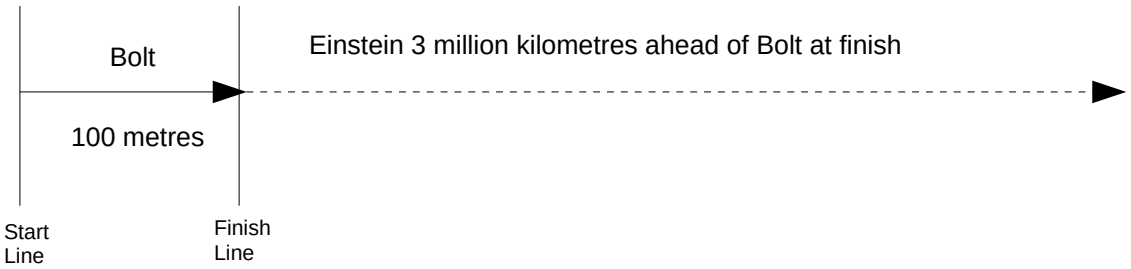
The failure to take account of symmetry, means that Minkowski 4D spacetime, as set out above, is fatally flawed. So the $s^2 = (ct)^2 - x^2$ equation, leading to an invariant s existing in hyperbolic space does not stand. A spatial period without a commensurate temporal period is stasis – a motionless statistic – while reality is dynamic process in SpaceTime. ***And since a period of time is equated with a period of light, which can be measured as a SpaceTime vector within the orthodox three dimensional framework, time as a fourth dimension is invalid. As noted above, all motion should be specified by vectors (including trajectories of micro vectors) to denote the length and direction of movement.***

Light is a scalar phenomenon which radiates in all directions from **X** as a sphere expanding at the speed of light. Minkowski's geometry selects one of those directions perpendicular to the object's direction of travel. However, when it comes to the motion of object **X**, the relative direction of light lies in the same direction in which Object **X** is heading. This can be illustrated with a little imagination. Einstein imagined himself riding a beam of light, so let's imagine him astride a beam of light, racing Usain Bolt when he was running the 100 metres in the world record time of 9.58 seconds.
The instant Bolt sprang from his starting blocks, Einstein streaked away from him at the constant speed of approximately 300,000 kilometres per second, and continued to

do so for every one of the 9.58 seconds that Bolt ran the 100 metres. So the instant Bolt reached the finish line, Einstein was some 3 million kilometres ahead, traveling away from him at the speed of light. The lesson here, is that before you enter a foot race, be sure to scan the list of other entrants to make sure the name of Albert Einstein is not among them. If it is, take up drafts instead. Or maybe not! On a serious note, ***Figure 9*** illustrates Usain's relativity problem. Figuring it out requires no triangular geometry or 4D spacetime.

Figure 9

Usain Bolt on foot, racing Albert Einstein riding a beam of light, over a period of 9.58 one second ticks on the official stop watch..



So Bolt moving 100 metres in 9.58 seconds can be shown as a vector commencing from the start line, whilst the distance light traveled ahead of Bolt can be shown as a vector pointing in the same direction and commencing from the finish line, as illustrated by ***Figure 9.***

Our perception of the distance that Bolt ran and the time that he ran it, will depend upon the relative SpaceTime position from where we view it. If we view it from the stand at the side of the track, we will see it very differently from if we view it from a high speed plane flying past. ***That is the essence of relativity. In seeking to describe motion from the an entirely invariant perspective, in which everything ultimately moves at the speed of light in 4D spacetime, Minkowski introduces an absolute which abolishes the principle of relativity altogether. In doing so, he implies that relativity is a subjective perspective of an invariant objective reality. Remember, relativity does not require a subjective observer to validate it. The principles underlying relativity existed from the beginning of the universe, long before there were observers.***

If we stretch imagination a little further, with Bolt and Einstein continuing their race around the surface of Earth, they would follow a trajectory which would be a negative curve as they circled Earth. But that trajectory would be in three dimensions, not four. Since Earth is spherical, all “straight lines” on Earth are intrinsically negatively curved. So a straight-line distance traveled on Earth is essentially a negatively curved trajectory. We might expect that a straight-line distance traveled ***within*** a finite universe, to be a positively curved trajectory (inside the curve rather than outside).

The dismissal of Minkowski 4D spacetime geometry has profound consequences. Einstein was initially sceptical, however he later embraced it in his 1915 General Theory of Relativity incorporating his theory of gravity, where a 4D spacetime continuum is conceived as a curved medium which is deformed by the objects which dwell in it.

Pythagoras’ theorem relates to flat “Euclidean” space in two dimensions. Minkowski proposes replacing it with a negatively curved four dimensional spacetime; while NMT proposes replacing it with a positively curved three dimensional SpaceTime.

So let's consider an alternative geometry by which we can track objects in motion as trajectories of events in 3-dimensional SpaceTime, starting from points of origin.

An Alternative Geometry

Let us examine the conventional frame of reference for relating points in three spatial dimensions. It is based on "Cartesian co-ordinates" (René Descartes, 1596 – 1650) related to three perpendicular axes, where the horizontal axis is conventionally labelled the **x** axis, the vertical **y** axis, and the depth **z** axis. The result is a cubic frame of reference within which we seek to define relationships between points by correlating them to the dimensions of the three spatial axes. However as we have seen, space alone is an abstract statistic, so whereas spatial representations such as points on a map have some utility, if we wish to define the reality of objects in states of relative motion we need a frame of reference which facilitates the dynamics of trajectories of SpaceTime events (SpaceTime periods) in any direction from points of origin. Hermann Minkowski sought to create a universal frame of reference with invariant parameters in a four dimensional spacetime, the result of which as we have seen is conceptually flawed. The question arises, can we create a valid universal frame of reference for relative motion?

The Spherical Frame of Reference for Motion in Six Directional Dimensions

Simultaneous motion is logically restricted to one-handedness. For example, we cannot move simultaneously in opposite directions. But we can move simultaneously in three one-handed directions: left, up and back for example. So our Cartesian cubic frame of reference for correlating events in three perpendicular spatial dimensions can be transformed into a frame of reference for correlating SpaceTime events as vectors in six perpendicular directions from a point of origin: left, right, up, down, front, back. Within such a frame of reference there are eight fields of possibility for combined one-handed vectors: left-up-front; left-down-front; left-up-back; left-down-back; right-up-front; right-down-front; right-up-back; right-down-back – which together add up to possible vectors forming the radii of a ***spherical frame of reference***.

A Spherical Field of Possibility

A SpaceTime event which is relatively "at rest" in the frame of reference in which it is viewed, gives rise to a Spherical Field of Possibility for subsequent potential cause-and-effect SpaceTime events. A sphere is a perfectly symmetrical form: divided in half from any direction, each half is a perfect mirror image of the other. "At rest" relative to an observer, it appears the same viewed from any direction, differing only in its scale which is relative to the distance from which it is viewed.

A plane taken through the centre of a Spherical Field of Possibility is a two dimensioned ***Circular Field of Possibility***, with its circumference/diameter ratio being the definitive constant 3.142…. named pi (symbol π).

Figure 10 shows a Circular Field of Possibility, arising from event **O**, with its four rectangular radial vectors (up, down, left, right) which divide the circle into quadrants for all possible radial vectors forming the structure of the circle. The direction of a particular vector within the circle can be specified in degrees clockwise from 12 O'clock. So, an **up** vector 10 units long would be 0^0,10. The same length **right** vector would be 90^0,10. As a **down** vector it would be 180^0,10. As a **left** vector it would be 270^0,10.

Let **O** represent an originating event giving rise to a Circular Field of Possibility, and let the length of its radial vectors represent a SpaceTime period of 300,000 kms in one second. So the area within the circle represents the field of possibility for events to arise

from **O** in one second at velocities up to **c** (the speed of light). We can consider the Circular field of Possibility to be an indeterminate state of all possible SpaceTime events which could arise from **O** within one second, whereupon one or more of the possibilities will be realized. With every additional second, the Circular Field of Possibility expands to form concentric circles of possibility for trajectories of SpaceTime events to be realized, commencing with **O** the originating SpaceTime event.

Figure 10

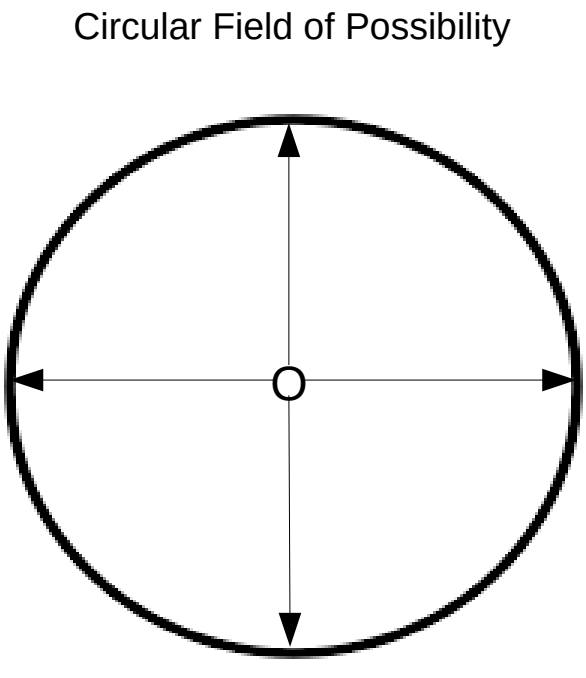
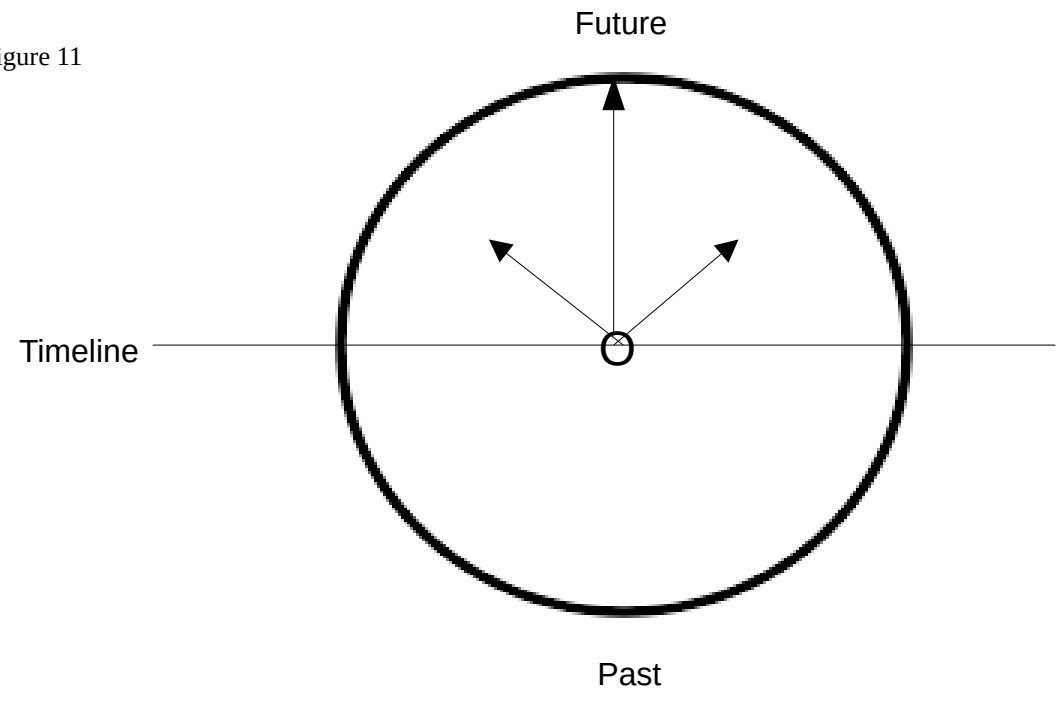


Figure 10 shows the Circular Field of Possibility arising from an object (**O**) which is contextually “at rest” relative to the frame of reference in which it is viewed. However, if **O** is in motion relative to the contextual frame of reference, the upper half of the circle is transformed into a left-right, bi-laterally symmetrical Field of Possibility, as illustrated in ***Figure 11***.
The horizontal timeline divides the circle into object **O**’s definite past and its possible future. While the vertical vector represents the axis of symmetry for the upper half of the circle (the field of future possibility).

Figure 11



O's future trajectory depends upon its velocity. If it is just above zero, it can be represented by a minimal length vector pointing in any one direction within the upper half of the circle.

Let **r** = the radius of the circle.
Let **v** = the SpaceTime velocity of object **O**.
Let **c** = the cosmological constant, the SpaceTime velocity of light.

If **O** were an object traveling at the velocity of light, such as a photon, its future trajectory can be described by a vector of length = **r**, and direction = **v/c** = 1, where 1 represents its direction of travel at 90^0 relative to the horizontal time-line.

If **O**'s velocity is half that of light, its future field of possibility can be defined as the area bounded by vectors of length **v/c** = ½ **r**, and direction = ½ 90^0 = 45^0 relative to the time-line, right and left of the axis of symmetry, as illustrated by ***Figure 11***.
Light emanating from the object would spread out over the sector of the circle between the extended 45^0 vectors, as illustrated in ***Figure 11a***. In the 3 dimensions of a sphere of possibility, this sector is known as the ***future light cone*** of the object.

Field of Possibility for Object in Motion (2)

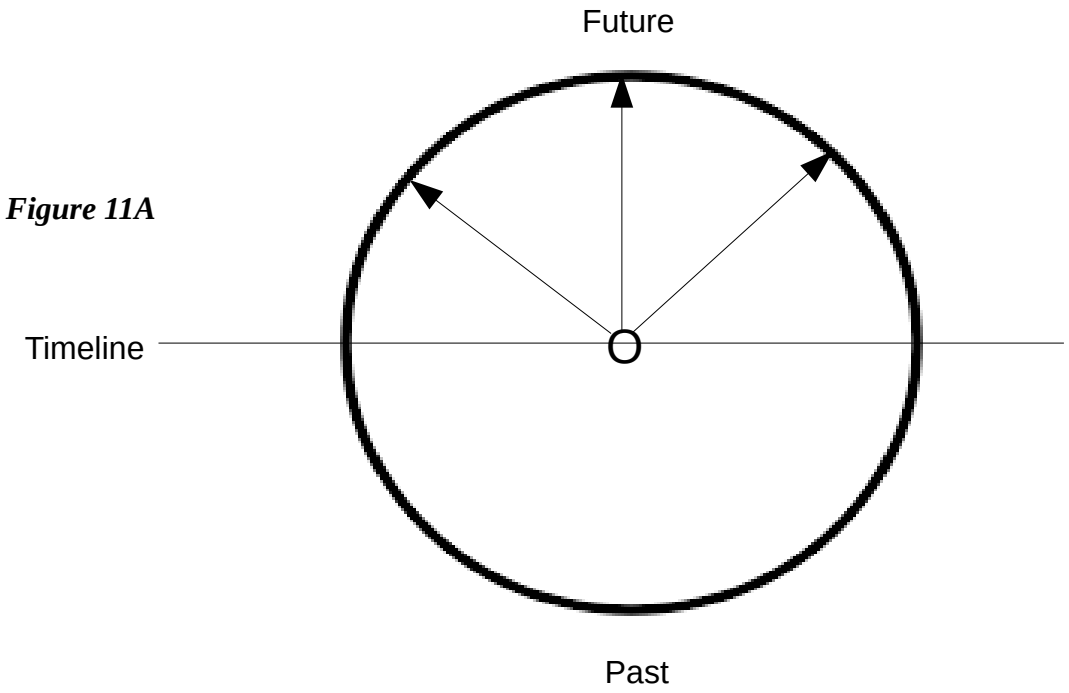


Figure 11A

To sum up, if **v** = 0 (**O** is at rest relative to the frame of reference in which it is observed) the field of possibility for future SpaceTime events (including light) caused by object **O** in one second is defined by the whole 360^{o} area of the circle around **O** (***Figure 10***). But the instant that **O** moves, so that **v** > 0 (**v** is greater than 0) the field of future possibility becomes restricted to the area above the time line, depending bilaterally upon the value of **v**/**c** as a fraction of the vertical 90^{0} velocity of light vector (***Figures 11 and 11a***). For the area outside the field of possibility to be influenced by **O** in one second would require travel faster than **c**, the theoretically invariant speed of light (refer to **Relativity and All That**, earlier).

While analysing space and time in abstract two dimensions is useful, its universal reality exists in three dimensions. If we add backward and forward vectors to the two dimensional Circular Field of Possibility, we arrive at a 3-Dimensional ***Spherical Field of Possibility*** with six main vectors dividing the field into eight sectors for all possible vectors within the sphere arising from **O** in one second. The spherical field of possibility as defined, will increase in scale every one second SpaceTime period, like a balloon inflating at the speed of light. Note: while the field of possibility expanding over SpaceTime is a 3 dimensional spherical wave, each of its vector radii is a two dimensional linear wave.

Unlike the orthodox three dimensional cubic frame of reference, a spherical frame of reference, with eight sectoral fields of possibility, allows for the description of all possible trajectories of SpaceTime events arising from a point of origin.

The Finite Universal Field of Possibility

A field of possibility is all the possible SpaceTime events which could arise from the realization of a causal SpaceTime event. As such the field is indeterminate possibility and not physical reality. In ***NMT*** the "Big Bang" gave instant rise to an indeterminate field of all possibilities (all possible degrees of freedom) in Nature's abstract mind, whereby any one of all possible universal dramas could unfold as trajectories of SpaceTime events on the universal stage (the field of potential). ***"All possibilities" are discrete, mutually exclusive and finite.***