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P = NP if time is probabilistic

Abstract

If time is an independent physical quantity on a self-avoiding *n*-dimensional walk, then finite random reorientation of metric endpoints gives time an active role in our measured interpretation of events. The discontinuity between random events and unavoidably well-ordered language leads to results that support a generalized *n*-dimensional equilibrium hypothesis that suggests: (i) constructive proof strategies for the equivalence of some NP-complete problems to P; (ii) the Riemann Hypothesis as an equilibrium function on the complex sphere.

Introduction

We are used to not knowing what time is. That is, if we define it at all, we give it a dependent definition. In non-relativistic terms, time drops out of our calculus. In relativity time is a metric continuous with space, as Minkowski spacetime, that changes sign in the curved metric of general relativity.

Suppose that time is a "real," i.e., independent, physical quantity. What would time look like then? We can deduce that a physically real time:

i. Would retain metric signature properties, or it would have no vectored measure and would be therefore not differentiable from a nonorientable space;
ii. Would in algebraic terms obviate the tensor metric (because to be independent of other physical phenomena, must be defined discretely independent of space, and time acting or evolving independently of space would thus give up no information about distance between points);
iii. Would have an *n*-dimensional signature[follows from (ii)];

iv. Would possess infinite degrees of orientability in an arbitrarily chosen dimension ≥ 4 [follows from (i)].

Given these deductions, we find that a rigorous definition of physical time would not differ from the infinite one-dimensional line of positive natural numbers, N*. (N* symbolizes the integers absent of zero.) To count is to measure discrete properties of space.

But "counting space" does not impart spatial identity to a physically real time. Rather, it suggests that counting does not originate by axiomatic assumption; the "natural" number line is continuous to *n* dimensions without altering its identity. In *The Meaning of Relativity,* Einstein said of physically real quantities (the principle of inertia in this example), in introducing the section on general relativity:

"Just as it was consistent from the Newtonian standpoint to make both the statements, *tempus est absolutum, spatium est absolutum*, so then from the standpoint of the special theory of relativity we must say, *continuum spatii est absolutum*. In this latter statement, *absolutum* means not only 'physically real,' but also 'independent in its physical properties, having a physical effect, but not itself influenced by physical conditions.'" [1]

We therefore propose the following definition:

Def. *Time: n-dimensional infinitely orientable metric*.

Time is thus not a distance measure, but a probability measure with a distance signature. The independence of events is therefore not determined by distance measured by the light speed standard, but is also not obviated by it in $d \leq 4$. A time independent of a defined dimensionality necessitates *n* orthogonally intersecting Euclidean planes, which begs the question that Einstein also proposed in Appendix II, "Relativistic Theory of the Non-Symmetric field,"

"…One can give good reasons why reality cannot at all be represented by a continuous field. From the quantum phenomena it appears to follow with certainty that a finite system of finite energy can be completely described by a finite set of numbers (quantum numbers). This does not seem to be in accordance with a continuum theory, and must lead to an attempt to find a purely algebraic theory for the description of reality. But nobody knows how to obtain the basis of such a theory." [*Op. Cit*.]

Let us suggest that the basis is lacking because an objective reality is not at issue and no basis is required. We don't mean anything mystical by that. We mean that even if the set of moments we call "time" is finite, an infinite orientability of the time metric suggests that whatever boundary conditions we arbitrarily choose in *n* dimensions ≥ 4, implies a well-ordered continuum. This does have a relation to the Hartle-Hawking formulation of imaginary time on the complex sphere [2], but we intend to generalize it further.

That is, we will introduce an *n*-dimensional equilibrium function. This leads to:

n-*dimensional equilibrium for self-avoiding random walk.*

The self-avoiding walk is a theorem by the given definition of time. We reiterate the meaning in (i), that time retains metric and vector signature properties, as measured, necessary to our understanding of plane-orthogonal orientation in computing connecting points. We mean to obviate time as a well ordered series of moments, and favor time as a complex function. [2]

A discrete walk is a finite step. We differentiate finite from infinite in this context, by a continuous function that discretely reorients endpoints on a line of indefinite measure that prescribes a discrete step node to node in n dimensions. Consider the rules of special relativity in this context: one sufficient definition for a faster than light particle is one that changes direction without changing velocity; i.e., a 180^{o} reversal at velocity c implies a time reversal.

But a time walk is necessarily self-avoiding. In Heraclitus's less technical terms, one cannot step into the same river twice. In our terms: the principles of thermodynamics.

To say that time is continuous with space (Minkowski spacetime) is not to say that continuous events are bound by the measured properties of a finite dimensional (Hilbert) space with infinite dimensional measure. How would one know? After all, every event is recorded "forward" in time, and local, while linguistic conventions are reversible and global. Mathematically, it is no feat to map four dimensional events "backward" onto two dimensions – but we don't live in two dimensions; we know there is a difference between an event and the language in which it is recorded. The dynamic map in which one actively participates in measurement is far more subtle and probabilistic, i.e., the rules of quantum theory do not specify equal units to define time steps (cf. John Wheeler, delayed-choice) [3], nor does general relativity cosmology allow continuous reverse steps in time free of singularities. [Suppose one could not differentiate a singularity from a move in time – the world would necessarily be measured on a surface of connected, simply-connected 3-spheres (Poincare´ Conjecture). The Poincare´ Conjecture in a theorem within our assumptions.]

Therefore, time as a probabilistic measure implies that discretely measured events are equivalent to discrete discontinuous identities in a continuous field. In fact, quantum theory already informs us of this: if not for Planck's Constant, the world would be smoothly classical. It is not sufficient to believe that "somehow," i.e., at some indefinite and unknown point, probabilistically measured quantum mechanical events smooth out into the classical world of our Newtonian intuition – because without the principles of nonlocality and uncertainty, quantum theory collapses entirely.

The possibility we raise, then, addresses quantum unitarity, while preserving the relativity of measurement in the Minkowski spacetime. Einstein believed this might be accomplished in a continuous field theory – we do not. Not even a quantum field theory of discrete relationships can discard continuous functions. Instead, we shall speak constructively of *continuous functions* in a space of *discontinuous measurement*. To say something constructively meaningful about a finite set of infinite things, we find, necessitates a principle of generalized equilibrium.

On 18 April 2003, an item appeared in the Usenet newsgroup sci.math regarding the four color theorem (4CT) that is suited to illustrate the thesis to follow, that of *n*-dimensional generalized equilibrium. The item, posted by billjones92057@yahoo.com, reads in part, "Speaking of proof – suppose there was a jar containing 10,000,000 balls. There may or may not be one black ball. How would you prove there was no black ball? This is how I see the FCT!! (sic)"

Of course, one surmises that Mr. Jones means proving the case short of individually examining 10^7 items. The discussion concerned the 1976 K. Appel and W. Haken (A-H) proof of 4CT, and the reduction of computer checked cases to the manageably finite set. It is not our intent to examine what the Usenet correspondent means by his claim, but only to look at what sufficient criteria determine a finite case in a practically infinite set, and how to objectively judge that sufficiency. Computation theory, like language itself, is a priori burdened with the assumption of algorithmic compressibility; i.e., communication of results demands that the input string be shorter than the output string. But when one speaks of input so large that in comparison to human comprehension it is a practical infinity, "shorter" ceases to have much meaning (cf. Cantor; numerable and indenumerable sets), and problems of computational complexity begin to merge with problems of physics.

That we do often solve problems by lucky guesses, that is, by non-deterministic means, is memorialized in a whole class of problems called NP, for non-deterministic polynomial time – where length of time is considered to grow exponentially in relation to input length. When we verify such a solution in linear steps, i.e., in polynomial time, the problems belong also to the class P. Known as NP-complete are those problems for which no solution is believed to exist in P (e.g., Boolean satisfiability, Traveling Salesman, Hamilton circuits) beyond a certain low threshold of complexity.

The very definition given to P and NP computational complexity, implies that "time" – just as it is used in physics – is a mathematical quality dependent on the mathematical quantity: real measurement. This is a very sharp demarcation between the mathematics of meaning and the mathematics of computation. By this, we do not mean that results in mathematics can be interpreted by different standards – but we do mean to say that what mathematics means in terms of axiom-burdened classical logic (propositions of the form $A \Rightarrow B$) are not necessarily the terms in which time-dependent computation lives. Many logicians and computer scientists, we venture, agree with Stephen Wolfram that it is "… far from clear that the general P = NP question has a definite answer within standard axiom systems of mathematics." [4] Mathematics, like literary language, is a static art. It has no calculus of time in which time is other than another static symbol in the language.

The world of the quantum, however, is dynamic. Quantum states change in probabilistic ways. Suppose with us, that this is equivalent to an independent calculus of time – if it is, we intend to show that time occupies a constructive role in the meaning of (non-classical) mathematics that can cast new light on the meaning of computation.

Peter Shor's quantum computing algorithm for factoring has been known only since 1994. [5] The consensus is apparently disappointment that this would not lead by now to faster quantum computing algorithms, or that the factoring success has not led to a successful strategy for attacking NP-complete problems. We are about to suggest, however, that what makes an NP-complete problem tractable is not the length of its input but the nature of its output – what we determine after looking.

Method

We speak of generalized equilibrium, in order to say something constructively meaningful about a finite set of infinite things.

To answer the question of how many maps one must examine to prove the negative existence of at least one map requiring k colors > *4* (the "black ball" case), we know that we must show that the number of necessary cases of four-colorable flat maps is finite – even though we also know that the plane is infinitely extended. Suppose we take the case of the plane on the surface of a finite sphere in three dimensions, then. Imagine a four colored beach ball. It is more or less obvious that we can draw an infinite variety of four colored maps on the ball, just as we could draw an infinite variety of such maps on an infinite flat plane. But we are not interested in how many maps we can count – we want to know that any map we happen to discover whenever we look, contains no more than 4 discretely colored areas that share a line segment border that is not a point.

That is what we mean by a finite set of infinite things, statically.

We intend to show that generalized equilibrium extends the meaning of this concept to n dimensions, in a precise manner, both statically *and* dynamically.

In so doing, we also intend to show that a well-formed question – such as that implied in 4CT – implies a well-ordered set. The closed linguistic judgment – that which makes the question well-formed – has objectively defined criteria embedded in its form:

Four color theorem restated: *There exist in the plane no number of closed curves > 4 that necessarily share more than one common border other than a point in the finite closed bounded area of the plane.* □ (*)

We understand by "closed curve," by the Jordan Curve Theorem, a space finitely bounded by a simple closed curve, because we understand that a closed curve divides the plane into two parts – one finite, one infinite. Would we speak of the infinite part? – then the conjecture is not provable by computer verification (i.e., algorithmic compression). Clearly, one must refer to n discrete closed curves within a finite area of the plane, of indefinite measure. There would be no possible compelling argument – as Appel and

Haken made – for unavoidable finite sets of flat maps, not for the reason of infinite area (imagine that the "beach ball" expands continuously, i.e., finite but unbounded), but for the reason of the choice between two areas in the divided plane. Only one choice is tractable to discrete manipulation of differentiable elements. If we address a two dimensional phenomenon from a three dimensional perspective, the dimensional cut produces for us, a uniquely defined finite space. [6] The means of production is not trivial; it is the very arithmetic function that bridges symbol and process:

There is a great difference – referring back to Mr. Jones's example – between the case of tossing a black ball into a churning vat containing *n* white balls, to calculate the probability of drawing it out again, and calculating the probability of finding a singular black ball where one has no knowledge of its ever having entered the vat.

We already know, in objective mathematics language, that there exist an infinite number of ways to draw a four colorable flat map. One has only to invoke infinite time (Heraclitus's proposition) – the connection to the open P = NP? problem is then apparent.; i.e., the result of an infinite number of calculations can't be looked at in a finite amount of time. We know what "polynomial time" in the P = NP? problem means both by linguistic convention and phenomenologically, but, like the term "infinity" in arithmetic, we do not know what the term "non-deterministic polynomial time" means except by definition. The definition necessitates an infinite process (infinitely increased length of input) to verify.

Unlike the 4CT, therefore, the P = NP? problem is not well formed by our definition of "well-formed." There are no certain objective terms in which P = NP can be tested. All the terms in (*) are precisely closed linguistically, and precisely, i.e. finitely defined phenomenologically. The mere fact that A-H can produce an algorithm that in finite time forces a result that exists in finite space, also forces the judgment that a closed curve in the plane need bound no more than three other differentiable closed curves at other than a point, for the defined closed curves to remain distinctly colorable. There is more than (classical) mathematical judgement involved here – one must judge that the phenomenon described in closed linguistic (mathematical) terms, is also closed phenomenologically. I.e., that there is the possibility of conclusion, by checking in a finite number of steps, that the statement and the phenomenon map1 – 1 in a process that terminates in a judgment on a finite space in a finite time. The P = NP? problem promises no such mapping.

To reduce the eligible 4CT cases to an algorithmically compressed number is itself a linguistically compelling process that does not depend on cultural terms, but on universally objective symbols – machine language that converts continuous geometric forms into discrete bounds that in some manner of speaking, interact – i.e., communicate information about their discrete positions in spacetime to each other. (cf. quantum nonlocality.)

A mathematician does the same, as she interprets the relationships among mathematical symbols communicating with each other, into identities, theorems and theories.

And while we conventionally think of "mathematician" as a coherent whole, this view does not comport with the process of actually doing mathematics – results do not, one surmises, spring from a mathematician's head as if worlds from the brow of Zeus. The more rational description of "mathematician" is the "triad of agencies" of Brian Rotman. [7] Rotman's concept defines producer and product operationally. Independent of anything one can say *about* mathematics or mathematician – his triad of Person, Subject and Agent dynamically and completely describes the transformation of language symbol into mathematical function. Indeed, one cannot imagine that language and function can be causally separated.

Person, Subject and Agent are discrete elements that dynamically guarantee a coherent closed judgment on any question tractable to objective analysis, because number defines an objective boundary. (Dedekind *Op. Cit.*)

Dynamically, then, we mean by a finite set of infinite things, discontinuous identities in a space of continuous functions.

This definition fits the essential Constructivist (Intuitionist) philosophy of mathematics as advanced by two early proponents (and as far as we can determine, followed in principle by all past and present practitioners, regardless of differing views on constructivist method):

a. All real functions are continuous. (Weyl) [8]
b. Doing mathematics necessitates "… a twoity …a movement in time …" (Brouwer) [9]

One assures a probability of 1/2 for not finding an uncertain discontinuity that depends implicitly on the above criteria, translated explicitly into the equation:

$$\frac{\sqrt{1}}{2} = \sqrt{\frac{1}{4}} = \frac{1}{2}$$

Generalized:

$$\frac{\sqrt{n}}{2} = \sqrt{\frac{n}{4}}$$

Unity, in other words, $n = 1$, is a twoity. (There really is no analytical reason why one should view the process of "counting" with an assumption of well orderedness in the sequence of natural numbers, which we cover in more detail in the Summary section.)

For this to hold, time plays an active role, as Brouwer allows, and continuous functions can be reduced to discontinuous identities only as *n* approaches infinity.

In the 4CT, we deal with the finite case of two-dimensional graphs.

As long as *n* is finite, the judgment is closed. If the judgment is closed linguistically, then there necessarily exists the basis of a true scientific theory to be measured against the result acquired by measurement (observation) – which is identical to an algorithmic compression. How does one know that the information one seeks to compress obeys the prescribed algorithm? One looks at the output. Compare the case of the assembled jigsaw puzzle; however complicated, one knows that one has the correct solution by examination. [10] This is the case with the 4CT.

Appel and Haken provide us with a defined set of four colorable maps. If we can agree that the set is four colorable, then examining randomly:

$$\frac{\sqrt{1936}}{2} = \sqrt{\frac{1936}{4}} = 22$$

is sufficient scientific, though not (classical) mathematical proof of the four color conjecture. If a randomly chosen 22 examples are correct, no matter how many times we repeat the process of examining random results, we should be confident with probability 1 that all the unavoidable examples are four colorable.

Why is our confidence not less than unity with the small sample size, and not improve with further examination? Our analysis is not Bayesian. We claim that the probability before looking will indefinitely remain at 1/2, and after looking at this precise random sampling, will collapse to unity:

That the four colorable set is defined precisely, is already a closed linguistic judgment on the four-colorability of maps in the plane. The test of this judgment does not depend on one's belief *about* four colorability (as in a Bayesian analysis). It depends on one's ability to acquire and examine maps by an objective algorithm. It depends on looking. The A-H proof satisfies these criteria.

The mathematical part of the judgment, the linguistically closed judgment, is primary. A scientific judgment – acquired by theory and result – can never be closed, in principle. If we disallow any objective value for an inductive judgment (i.e., theory has no dependence on result, and vice versa), we will find that theory and result are *completely* independent; speaking quasi-numerically, this amounts to an infinite gap. [11] We bridge that gap, without making a metaphysical leap of reason, with the *n*-dimensional equilibrium whose description will shortly follow.

When we say that the probability for not finding a targeted sample is 1/2, we don't mean that we can never be better than half sure (or have more than 50% statistical confidence) in the accuracy of a judgment. We mean that the linguistic judgment can never prescribe more than 1/2 of the judgment in a unified theory-result, which is equivalent to a complete scientific theory, the highest truth value that science can bestow. Again, this is the case with A-H and four-colorability. A-H determine the unavoidability of a finite set of cases of flat maps by "looking" at the boundaries of the problem space and closing the judgment. In the simpler case, it is metaphorically as if I were to look at an assembled jigsaw puzzle, and then ask if there is any other way in which this puzzle can be assembled and yield an identical picture. I would break the problem down according to theorems of symmetry and rotation – my judgment is concerned with the ways in which the picture can change, not with arbitrary changes in the position of the cuts from which the pieces are assembled. The ways in which I view the picture are completely independent of the ways in which *n* number of pieces can assemble to form it; i.e., the assumption is of a singular picture accommodating an infinite number of cuts. The analogy is exact – the unavoidable A-H set is a singular four colored map accommodating an infinite number of non-point boundaries among the colors. One cannot in fact classically prove the existence of a finite number of four colored maps in a case by case examination of infinitely shifting boundaries – time must be taken directly into account, and we can't do that classically, because "infinite time" has no symbol nor calculus. When one cannot fix objects, one cannot use induction. "The map" is a singular picture, a quantum found in *n* states. The "unavoidable" states that A-H arrived at by methods of proof by contradiction building on the earlier work of Kempe, Heawood, Birkhoff, et al [12] is the best that classical mathematics can offer in the way of proof methodology. This is for the fact that only by invoking the principle of excluded middle on which proof by contradiction rests, can classical mathematics avoid avoidability – what we mean by that, is that the finite set is assumed in order to prove the necessary existence of another finite set with contradictory properties. So what is done, in effect, is to assume what one is trying to prove – namely, that the set of four colorable flat maps is unique. To be sure, the sophistication with which this is accomplished is compelling, and this paper is not the forum to argue classical vs. constructive proofs. What we do suggest is that explicit construction does not try to avoid avoidability, and accepts that real functions are continuous: of all the infinitely many four colorable maps that can be constructed, we hold tractable the question of nonexistence, i.e., if "four is sufficient" holds by construction (th. *), then our closed judgment on the bounded part of the plane secured by the Jordan Curve Theorem says nothing about the unbounded part. And yet we may allow the bound on our judgment to grow to infinity ("finite but unbounded.")

To illustrate further:

Suppose I make the claim that thunder is caused by angels bowling in heaven. Prove me wrong!

If you tell me that I have no objective definition for "angels," much less for heaven and celestial bowling balls – I want to tell you that I have a theory incorporating 10 dimensions, with 6-dimensional angels rolling 4-dimensional bowling balls. (We shall return to this metaphor in the Summary section, with a more serious treatment.)

You might want to call "angels" and "heaven" and "bowling ball" by different names, but my linguistic judgment exists independent of my means to test the truth of it. Likewise, the result exists independent of the linguistic judgment.

The scientific theory of thunder that we find testable, is also independent of previous results. It is based on other theories – other closed linguistic judgments – called e.g. "the kinetic theory of matter" and "thermodynamics." One therefore doesn't need angels and heaven and the excessive complications that come packaged with those ideas, in order to explain thunder, as Laplace had no need of the God hypothesis to explain his celestial mechanics. Take another example – a stick that appears bent in the water, sufficiently explained by water spirits below, deceiving one's eyes. Without Fermat's principle of least action and the theory of optics, there is simply no objective basis to explain the phenomenon. But we don't need to ever have seen such a stick in order to know that principle and theory. And neither can one assess the actual physics by lifting the stick from the water; water spirits, after all, don't live in the air. In short, we need not rely on a radical empiricism or logical positivism to make true statements and test them against result. Empirics and logics then become useful tools rather than metaphysical assumptions.

Point is, nothing in principle prevents any linguistic judgment from being tractable to objective analysis – given an infinite amount of time.

The result to follow will show that if time is allowed to go to infinity on a random walk in *n* dimensions, then the counting function is a uniquely predicted property of the brain mechanical function of a three dimensional creature existing in a four dimensional spacetime.

This is, we maintain, the sufficient basis for one's ability to make critically rational judgments independent of personal experience, and test personal experience against objective language without invoking infinity. [13]

Result

Take identity as probability:

$$(P)\sim p = 1 \qquad (1)$$

(Read: "The probability of 'not-p' is unity.")

This again leads us back to Mr. Jones's question – the question of how to prove nonexistence, constructively.

Our claim here, is that the probability for nonexistence of the black ball before looking is precisely 1/2, and the proof for a probability of unity after looking is to be had by randomly examining only 1582 items. The reduction is obtained, for reasons to be explained, by:

$$\frac{\sqrt{10^7}}{2} = \sqrt{\frac{10^7}{4}} \approx 1581.14$$

How is it that one can isolate such a miniscule set of cases for random examination to assure with probability 1, not finding the item sought? The number is miniscule only in relation to the large sample. Suppose there were only 10 balls:

$$\frac{\sqrt{10}}{2} = \sqrt{\frac{10}{4}} = 1.58$$

We examine two balls of the 10. By conventional probability with perfect information (i.e., we know for certain that one black ball may be found and validated present with probability 1/5 for each examination), one knows that the probability for the presence of the black ball does not improve after a sufficient number of statistically significant trials. But our case is not analogous. To reiterate the main point – *we do not seek to verify existence inductively, but to prove nonexistence constructively*. The difference is critical:

The ball that "may or may not be there" is a singularity in an n-dimensional space.

Superficially, it would seem that we are saying that whatever n we assign for a number of four-colored flat maps will tell us what we need to know to answer a question that we may or may not ever find evidence to answer. But more than trivial is the algorithm by which one acquires n. There is a great deal of difference between tossing a black ball into a vat to calculate the probability of ever drawing it out again, and calculating the probability of finding a black ball where one has no knowledge of its existence.

What we really have to figure, is not the probability of finding the one black ball in the vat, but the probability of the ball's being able to exist in that domain. How does one calculate those boundary conditions? Quantum mechanics has already given us the answer:

One doesn't.

One cannot prescribe the wave function so as to predict the state of the randomly changing maps on the "beach ball" at any chosen moment, because the moments are not deterministic. To find out, one looks. Every time one looks, one finds:

$$\langle \psi | \psi \rangle = 1$$

This is the equation for quantum unitarity. It tells us that the quantum wave function, with its complex conjugate, comes with a probability of unity for one's observing the wave function in a given state. Quantum unitarity, we claim, is identical to (1). We make this claim because it precisely frames the complete independence of theory and result. It says that if there exists a completely closed linguistic (i.e., mathematical) judgment, the probability for not finding the function of the judgment in that same state, is unity. Mathematics (i.e., numerical) language is in fact the only linguistic means of closing a judgment that assures the output function.

Rotman's dynamic definition of mathematician as Person-Subject-Agent enhances the argument because it forces a relation between event and measure that does not assume identity between event and measure (i.e., it obviates induction entirely).

Our result depends on the assumption, besides that of the *n*-dimensional infinite orientability of the time metric, that our measurement methods are compelled by the properties of a continuous backward-forward projection between four dimensions and two. This second assumption is actually a corollary of the first; such a projection begs the complete orthonormality by which the finite dimensional Hilbert space is defined on a sphere of radius 1, which in turn begs ordered sets. In other words, the vertical projection of boundary points in four dimensions (the 3-sphere) onto any planar (2-sphere) surface, however randomly examined, is ordered by the self-limiting phenomenon of the space in which we exist and in which our thinking mechanics operates. (cf. Kant.)

This implies a sharp demarcation between language – which is always well ordered – and random events, which are never well ordered.

But if one takes language to describe a random event – suppose a four colored beachball bounced into one's arms – the well orderedness of the language "de-randomizes" the event by translation into the terms of the language. The event becomes pseudorandom. A story I remember from my youth which these days might be deemed politically incorrect but is illustrative for our purposes nevertheless, concerns two young men discussing what it means for a woman, in the slang term of the day, to be "stacked" – does one mean from the waist up, or does one mean to begin at the legs? One of the young men argues, "You can't start stacking something in the middle." Yet in terms of the orderedness of integers, that is exactly what one does. This orderedness is intrinsic to every arbitrarily chosen zero point. One cannot describe random sequences in other than well ordered terms. The intrinsic contradiction sharply demarcates language and event – if time is probabilistic. That is how we derive (1).

The class of problems that can be well-formed, then, is tractable to well-ordered counting, and well-ordered counting in computational terms gives us:

The P = NP theorem

A solution to any problem of the form (P)~p = 1, that exists in non-deterministic polynomial time (NP) also has a polynomial time (P) solution. □

Proof:

1. The probability of the inequality p ≠ p is 0. If the probability p = p is unity, then the identity is equivalent to:

$$\frac{\sqrt{n}}{2} = \sqrt{\frac{n}{4}} = 1$$

where the integer solution $n = 4$, and $n = 4$ when the dimensionality in which the output is measured is $d = 4$.

2. $d = n$.

3. Therefore, any n-dimensional output other than unity describes a probabilistic relation between an event and its measured interpretation. (The event and the measure are independent.)

4. The polynomial time measurement is therefore equivalent to the non-deterministic polynomial time measurement, because there is no measurement output in d < 4, for the reason to follow:

5. For $d = 1,2,3$, $n = \mathrm{d}$, $\sqrt{\frac{n}{4}}$ is less than unity.

6. For the expression $\sqrt{\frac{n}{4}}$ $n < 4$, the exponential (NP) time $\left(\sqrt{\frac{n}{4}}\right)^X$ approaches zero as n approaches infinity.

7. For $\sqrt{\frac{n}{4}}$ $n > 4$, there is no difference between linear (P) time and exponential (NP) time, as the expressions:

$$\left(\sqrt{\frac{n}{4}}\right)^X \text{ and } x\left(\sqrt{\frac{n}{4}}\right)$$

increase monotonically with the value of x. And while this is also true for any positive integer coefficient > 1 that would be substituted for the radical expressions, the radical denotes a compression of n dimensions as n approaches infinity that the real positive one-dimensional number line N* cannot supply by induction.

That is, n-dimensional equilibrium at infinity is the same as at unity, on the one-dimensional line of real positive numbers. $\frac{\sqrt{n}}{2} = \sqrt{\frac{n}{4}} = 1$

[Exponentiation (NP) growth will see the value approach zero, as the exponent approaches infinity. Linear (P) growth will see the value grow half as fast as the natural number line N* in (6). But when both variables n and x are allowed to go to infinity, and time is probabilistic, "half as fast" is a real measure of the probability of reconciling theory and result as discontinuous identities in a continuous function space limited by the dimensionality in which a result is measured. Therefore, though the expressions $\sqrt{\frac{n}{4}}$ and $\frac{\sqrt{n}}{2}$ are identical, we claim that they are discontinuous and that the identity is a result of the continuous backward-forward projection of points between dimensions 2 and 4. In other words, we maintain that Brouwer's "twoity" of the line and plane is equivalent to a "fourity" of the complex plane and sphere.]

8. Because the linear and exponential values of the fractional coefficient (1/2) vanishes (6) for arbitrarly large x, $\frac{\sqrt{1}}{2} = \sqrt{\frac{1}{4}} = \frac{1}{2}$ and vanishes for all positive integers < 4, we find that all algorithmic output in real positive terms (i.e., any real measurement) is a phenomenological consequence of $n = d = 4$, which is unity. (Quantum unitarity is obvious.)

9. If, by (7), radicals and rational functions may be substituted for real number coefficients, then because Abel's proof establishes the case for a complete finite set of roots to equations of degree 4 and lower by these arithmetic methods, the equivalence of P and NP depends only on a definition of "time" that obviates the measure of time by cumulatively even steps – and without regard to whether that growth is linear or exponential. [See note in (8).] Finite solutions exist both in P and NP for problems calculated in d = 4 (which is the only class of problems that mechanical calculation can recognize, in that calculating mechanisms have a finite existence in that dimensionality, as true of a human brain-mind as of a computer).

10. Therefore, a probabilistic definition of time ("*n*-dimensional infinitely orientable metric") establishes a relation between event and measure that does not depend on continuous time, only on continuously iterated mathematical functions.

11. Insofar as an algorithm is a continuous mathematical function, guaranteed *n*-dimensional equilibrium is not partial to whether a specified problem is solved in P or NP; it is partial only to proportion, recursion and output function.

12. P = NP, and the proof is complete.

□

The finite set of infinite zeros of the Riemann Zeta function, is another example of proving negative existence of a singular anomaly in an ordered set. What "may or may not be there" is bound by the observation and calculation of what we already know is there.

We present the theory supporting generalized equilibrium in an infinite ordered set such as the zeros of the Riemann Zeta Function which form the Riemann Hypothesis (RH):

$$\forall n \in N, \frac{\sqrt{n}}{2} = \sqrt{\frac{n}{4}} \Leftrightarrow RH \qquad (2)$$

That is, if the RH is an equilibrium function on the complex sphere, an infinite set of zeros of the Zeta function will always be counted as an ordered set on a one-dimensional line (a singularity in the critical strip), because the inverse function space as defined by

$$\zeta(s) = \sum_{n=1}^{\infty} \frac{1}{n}$$

which is Euler's Zeta function extended by Riemann to the complex plane for values of *s*, is exactly what we mean by the appearance of discontinuous identities in a space of continuous functions realized in the continuous projection between dimensions 2 and 4. The real zero result of the function (absent the trivial values, the even negative integers) is obtained in the complex plane at the expense of losing information regarding "size" -- i.e., the universal set of complex numbers is not ordered.

The set of complex numbers (*z*), we claim, is self-organized. The Zeta function produces a real zero for certain values of *s* with non-unitary monotonically increasing imaginary part, because self-organizing implies self-limiting.

The RH is a deducible consequence of self-organized dimensionality. By that, we mean that self-similar properties in two dimensions are self-limiting in four dimensions. Thus, the "twoity" (Brouwer) of the line is a "fourity" of the complex plane. Abel's result (1824) informs us of a complete finite set of roots in algebraic equations of fourth degree and lower, by the arithmetic methods of radicals and rational functions. If we speak in arithmetic terms of well ordered counting, it is not because the integers are out there in a Platonic world apart, but because the world has the necessary and sufficient dimensions to beg the orthonormality and spatial completeness by which the Continuum is deduced in sampled results that depend on that finite set of infinite well ordered objects.

As a consequence, the Riemann Hypothesis – like the Continuum Hypothesis [P. Cohen 1963] – is unprovable in classical mathematics.

Summary

In his seminal 1934 work, *The Logic of Scientific Discovery*, and later in *Conjectures and Refutations* and *Objective Knowledge*, leading 20th century philosopher of science Karl Popper set the standard for the independence of theory and result. H e rendered a precise methodology to demarcate science and philosophy. The demarcation problem promises to become ever more important as scientific results and mathematical judgments become ever more identified with each other.

Such is the case with string theory in physics. This non-empirically based theory is the source of our whimsical "angels bowling in heaven" metaphor earlier – a 10-dimensional *ubernatur* that theoretically imparts measured phenomena to the observed world.

Frequently in his papers and lectures, string theorist Edward Witten will speak (we paraphrase) of a "21st century theory discovered in the 20th century" that will take its place of precedence in physics "when we know what it means." Is it science or is it angels?

String theory fundamentally unites the two disparate theories of physics—general relativity and quantum theory – in a self-consistent mathematical description that subsumes these theories. [14]

Science in the Popperian meaning as we interpret it, is the measured correspondence between theory and result. [15]

So string theory is science, even in the Popperian sense, as it captures the dependence of theories on its internal consistency. In other words, if the standard model of particle physics is falsifiable, and general relativity or another theory of gravity is falsifiable – then string theory is falsifiable (as Witten claims, in fact).

But it is because this correspondence is measured – and not conditioned on either theory or result – that meaning itself is conditioned on the *independence* of theory and result.

And that, we claim, is equivalent to the independence of language and meaning.

Philosophical positivists (whom Popper successfully opposed) wanted to derive meaning from perception and invent language to describe it – making no distinction between knowing something and thinking something. Popper said that thinking something and knowing something are distinctly independent – that these processes can only be methodologically reconciled:

Results determined *in* language, and not *by* language.

As a significant matter of history in the philosophy of science, Popper early on decided that Darwinian evolution could not be a true scientific theory because its results could not be measured. Then he later reversed himself – realizing that the explanatory power of the theory of evolution united a host of disciplines and subdisciplines from biology to paleontology to geology and more … all of whose results are falsifiable. The theory therefore does allow measured correspondence between theory and result.

Just as important, though, Darwinian evolution (and we claim, any well formed scientific theory) gives theory a primary role. Evolution clearly states, in objective terms, what it is a theory *of* – i.e., common ancestry. Its unit, the cell or in the modern synthesis a reduction to material found in the cell, can account for structures more complex and perhaps infinitely so.

Now, if evolution is a theory of common ancestry and conditioned on an external reference to self organization, what is string theory a theory of? Like evolution, it too incorporates a fundamental unit of self organization that is said to organize into the complex effects we perceive in physics.

Easy enough to say – but the mathematics demands that this happens in 10 or 11 dimensions. Not even the *Bible* or the *Gilgamesh Epic* asks us to believe anything this fantastic. Nevertheless the theory makes sound predictions of both gravity and quantum mechanical effects in a seamless progression of mathematical argument.

What is string theory a theory of?

Let us suggest that it is a theory of the self organization of dimensions. While we do not easily comprehend what it would be like to measure some quantity in 10 or 11 dimensions, we do comprehend the concept of “dimension” itself, in terms that are tractable to objective language. And we have a notion of other abstract mathematical terms that self organization requires: e.g., symmetry, equilibrium, orderedness and regression to the mean.

These are the same terms that allow us to dwell on the difference between validating existence inductively, and proving nonexistence constructively:

Mathematical induction is axiomatic. In the Peano-Dedekind axioms of arithmetic, “Any property belonging to 0 (or 1) and to the immediate successor of 0 (or 1), is shared by the set of natural integers.” The axiom of induction therefore also says something meaningful about a finite set of infinite things. But the statement (as indeed are all axioms) is self-referential, circular; it says that induction is inevitable because the integers exist and the integers exist because mathematical induction is axiomatic.

Were we to construct the integers, however, we would begin with no such assumption. Our unavoidable assumption would be instead, that geometric symmetry is more fundamental than arithmetic induction. But because we are three dimensional creatures equipped with four dimensional brain-minds, we live in an asymmetric world. There aren't any mathematically ideal objects out there, no "pi in the sky" as John Barrow puts it. We order the ideal. That is the fact that demarcates the language of mathematics from the theory and result of science.

The result (2) is based on a theory of continuous projection between dimensions two and four, begging central symmetry on a space that has no center. If one accepts that time is an *n*-dimensional infinitely-orientable metric, then the time singularity is on a random walk apparently directional and self avoiding, by what we observe of physical processes, e.g., the second law of thermodynamics.

Like the child's riddle concerning how far one can go into a forest, our boundaries of observation are just as described by quantum unitarity, i.e., $\langle\psi|\psi\rangle = 1$, with the integers uniquely bound at unity as supported by (2), which is equivalent to a one dimensional line:

$$\frac{\sqrt{1}}{2} = \sqrt{\frac{1}{4}} = \frac{1}{2}$$

$$\frac{\sqrt{4}}{2} = \sqrt{\frac{4}{4}} = 1$$

Self limiting four dimensional observation does not then obviate *n*-dimensional existence. Thus, one may view the universal set of complex numbers as a self-organizing system, and the natural numbers N* deduced by (2).

There is no analytical reason that "counting" should be axiomatically dependent on an assumed least element. Complex analysis leads us to an even more "natural" synthesis of the origin of counting, and by implication a clue perhaps to the origin of language itself. Well ordered sequences give birth to the well ordered language necessary to a closed judgment – the singular result.

Probabilistic time informs us that even if all real functions are continuous, events are not – identities between discontinuous events are a product of the self organized system in which random (i.e., not ordered) elements orient to a well ordered judgment. We call these elements "dimensions," and allow infinite relative orientation. The measurement of time evolution, then, is a metric accommodating infinite random orientation independent of relativistic restrictions (i.e., time is "physically real") and this is, of course, equivalent to quantum unitarity.

We concur with L.E.J. Brouwer's characterization of mathematics as a "languageless activity of the mind," and a mathematical operation "a falling apart of a moment in time into two distinct parts." We find that Brouwer's essential "twoity" suggests that the twoity of the line is a fourity of the complex plane. Thus, the Riemann Hypothesis as an equilibrium function on the complex sphere.

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