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There has been little correspondence beyond that mentioned in Noesis 46. The two pieces received were both from Ronald Hoeflin; for want of space, we will discuss them in a future issue.

The Resolution of Schrodinger's Paradox: Reality Research in the Computational Universe

In recent issues, we have established - perhaps to the limits of the logical sophistication of the average member of this group - certain aspects of the overall structure of reality. We have defined a generalized "oracle machine" whose logical structure is the syntax not only of all we can observe or test for directly, but of all that is conceivable to the human mind. Because such machines are already established conventions in the field of abstract computation theory, we were granted temporary immunity from objections concerning their "unreality" or "impossibility".

But the immunity needed only to be short-lived; predicates like "unreal" and "impossible" are themselves open to objections which effectively redeem the concept of nondeterministic computation. We needed only to "relativize" the concepts "determinacy" and "nondeterminacy" to the *accepting syntaxes* of the Γ-subautomata with respect to which they are used. Where *information* is defined in terms of efficacy or relevance, it too is relativized to the acceptors on which it is effective. Because such acceptors may be defined arbitrarily within Γ, this reflects no loss in the utility of the relativized terms. In fact, they become meaningful in even more exact and scientific ways, and one wonders how their erstwhile fuzziness was ever tolerated within the self-contained, and thus didactically pseudotautological, scientific community.

A new branch of science has arisen which reflects the situation. An offshoot of what has been called "the crisis in physics", it purports to seek an adequate model of reality among the ruins of the classical, deterministic-mechanistic worldview which evolved alongside Newtonian mechanics. The demise of this eminently pragmatic picture of the world has long been a foregone conclusion among modern physicists, whose intuitions have been stretched by seemingly antimechanistic notions like general relativity and quantum indeterminacy. This new science has been called "reality research", and it has been the subject of much entertaining - but sometimes confusing - popularistic literature.

Of course, since popularizers relay knowledge taken from "primary sources", not all the blame can be heaped on them. In many cases, they are to be congratulated for their courage in venturing outside the sanctified circles of their colleagues...whose scorn for those who feed at "the trough of mass communication" is well-known. Feeding at the trough of a corporate or taxpayer-funded institution, while it may be a step or two removed from scientific journalism, is likewise no ticket to apotheosis; both levels are essential to a scientifically literate society. Few among us have remained so true to the ideals of knowledge that we can live out of Socratic bathtubs, reject all outside demands, and abjure all forms of salesmanship (though I admit to having come close).

Reality research, as generally practiced, has led nowhere. The reasons are multifold: the intuitions of its practitioners are still in shock, struggling to stay afloat in a witch's cauldron of weird mathematical formalisms which bear little similarity to the structures encountered in everyday life. These formalisms not only seem alien to quotidian existence, but are hard to integrate with one another; those who study quantum gravity, for instance, are obvious victims of translative difficulties. But perhaps the most important reason is that physicists are faced with a bewildering array of perspectives on the meaning of quantum phenomena.

The search for an overall view of reality, including man and his peculiar preoccupations, has traditionally been considered the province of philosophy. How, apart from its fancy new name, does "reality research" distinguish itself from plain old "philosophy"? By particular attention to the modern oxymoron known as "quantum mechanics". The term is oxymoronic in that quanta are generally considered to be statistically predictable at best, whereas the physical usage of "mechanics" derives from the deterministic Newtonian mechanics which reigned over science for the two centuries preceding this one. This usage is still current, due mainly to the fact that quantum theory has never been deemed essential to most of the applied sciences. That is, most science and technology is concerned with larger-scale effects which do obey laws which have been deterministically formulated.

Many theories purporting to be "scientific" - including those encountered in the socioeconomic disciplines, which are almost absurdly fallible in their determinations - are explicitly statistical. This is usually written off to the number and complexity of parameters for which such theories must account, as well as to the notorious difficulty of predicting the outputs of many variably-programmed human "transducers". But it has seldom been claimed that improvement is impossible, given ways to acquire and handle larger amounts of data. This situation differs sharply from that of physics, in which science appears to have reached certain ultimate mensural limitations. Here, the means of measurement have been shown to interfere unavoidably with measured quantities; when a physical quantum is measured, the measuring device must interact with it and disrupt its state. This, of course, bodes ill for the formation and validation of theories linking the states of quanta with the events in which they participate.

Yet, it has always been expected of physical theories that they should not only allow prediction of phenomena, but account for the mechanisms presumed to underlie them. This attention to causality has been prematurely jettisoned by those who assume that logic can exist without benefit of reason. Cybernetics, the machine science, has been consistently formulated such that mechanism and causality can be identified with constraint, which obtains whenever variety is restricted...in short, whenever a theory can possibly give more than chance predictions. Since the only theories of any interest or use are those which improve upon coin tossing, the existence of such a theory implies mechanism and so causality. This syllogism is a property of the logic in terms of which we comprehend the world; without it, neither statistical nor inductive probability can be justified. The confusion arises when we attempt to place unjustifiable restrictions on mechanism...e.g., that it be "material" in the sense defined on our particular accepting syntax.

Obviously, theorists who propose to do away with the concept of causal mechanism in favor of statistics tacitly propose to use those statistics inductively - i.e., to make predictions. But this forces them to define some equivalent concept in its place. Their criticisms are like word games played by truants at the expense of their lessons, and cannot be suffered in the classroom of logic.

Mechanism is reified constraint. Single-argument (logical) constraints differ generically from statistical constraints only in the extent to which elementwise distribution is possible...by inductive limits on the range of quantification. Constraint thus attends any reduction in variety, which we may identify with probabilistic freedom. So mechanism attends alongside it. Theories are useful only when they substitute predictive veracity for variety. So the existence of useful theories implies mechanism, and any such theory necessarily models the "automata" to which it applies. Objective mechanism is thus seen to be an outward projection of the "hard-wired" logic of our inner mechanisms. The precybernetic version of this truth originated publicly with Kant, and was not difficult to reformulate in light of modern insight concerning the structures of computative devices like human brains. The sheer mathematical necessity of this reformulation is so evident, and so obviously crucial to "reality research", that the delay in its discovery must be ranked a major curiosity.

This gap has been spanned by the CTMU, which may accordingly be considered the last word in "reality research". It may inspire sorrow to see the lid slammed on an emerging "branch of science", particularly one which seemed to promise so much to so many in the form of literary royalties and the like. But lids can double as foundations, and this one bears appreciable weight. Its importance thus overshadows the priorities of individuals who may (or may not) have planned to capitalize on the hole it covers

The quantum-mechanical oxymoron has frequently been portrayed as the Achilles' heel of Newtonian mechanistic reality. How, it is asked, can reality resemble a deterministic machine, when the laws by which it operates are nondeterministic? Mechanism is challenged by mystical concepts, like "quantum holicity", which would - despite certain real conceptual assets - have been laughed off the stage of science at any other point in recent history. But the challenge is not fatal. Werner Heisenberg, the inventor of matrix mechanics, showed that it is possible to replace certain elements of the Newtonian machine - dynamical variables in the classical equations of motion of a particle - with probabilistic matrices, resulting in a coherent "statistical mechanics". The question thus becomes: what grounds exist for discarding the notion of machine in favor of its negation as a model of physics?

The answer, not fully recognized prior to the CTMU, was hidden in the work of certain extradisciplinary contemporaries of Heisenberg and and the other founding fathers of quantum physics. The "extraneous" discipline in question was the newborn science of computation theory, notable among whose inventors was the British logician Alan Turing. Turing effectively showed that machines attempting to compute each other's structures and behaviors can generally achieve no more than statistical accuracy in their mutual determinations. Norbert Weiner and Claude Shannon, whose labors were eventually joined in the modern theory of communication, then evolved a formalism wherein mechanical behavior - the "dynamics" of mechanical systems - is represented by probabilistic state-transition matrices. Parallel to these developments were certain arcane advances in metamathematics, whose bearing on real logical machines was not fully understood by pre-CTMU theorists.

Matrices of transition probabilities are governed by mathematics generally invariant with respect to interpretation. On one hand, such matrices can be interpreted in terms of quantum states; on the other, in terms of machine states. Where, then, is the crucial distinction between physics and mechanism to be found? One fact is obvious: it is certainly not to be found in the formalistic intersection. Any attempt to vitiate the mechanistic view of reality on the basis of quantum-formalistic probabilism is thus preordained to failure. Quantum indeterminacy can be validated only as a characteristic of our particular relationship to the reality-machine. That particularity is the cue for relativization, which in this case can apply only to the term "indeterminacy". This relativization implies others, and the overall relativization which results is the CTMU...a kind of "logical general relativity" (as we have remarked before, the need to relativize indeterminacy does not directly imply that the universe is deterministic).

So the "crisis in physics" can be reformulated as a crisis in logic. The basic problem in "reality research" is usually called the *quantum measurement problem;* it centers on the mensural collapse of the quantum wave-function. Like Newcomb's (or any other) problem, it has an antinomial formulation: the "Schrodinger's Cat" paradox. The sorry plight of this animal was described by C. Cole in issue #43 of this journal. In it, Schrodinger - the originator of wave mechanics, the diffraction-oriented version of quantum mechanics - managed to encapsulate with devilish ingenuity the problem of defining the means and scheduling of quantum collapse. Unfortunately, because his formulation rendered the feline incomminicado, he was unable to pose his question to it directly. Had he done so, he would no doubt have been answered by a *cat-mew* (see the final paragraph on page 11, issue 44).

Schrodinger's formulation was clever in that it incorporated a critical range of possible junctures for quantum wave-function collapse. It involves an emitter; a quantum; in its original form, a calcite polarization-splitter; a quantum-detector rigged to a mechanical apparatus; a lower form of life (the cat); and a higher form of life (the observer). The quantum is emitted, filtered, and detected, whereupon its state determines whether or not the device kills the cat. The question is, which juncture gets the first shot at converting the "nondeterministic" quantum "wave" into definite, deterministic information? (For now, we will ignore the filter.)

The question is logical, and calls for a logical answer. While most problems in physics demand exact quantitative determinations, this one is so basic - so metaphysical - that quantity is all but irrelevant. The decisive generalities may accordingly be analyzed directly, without benefit of abstract symbology. It should thus be possible to answer Schrodinger's question in plain language without sacrificing clarity or concision. As this is done out of consideration for my readers, I do not expect to be counted lax for dereliction of my scholastic duty to obfuscate.

The proper resolution of any paradox requires that we closely examine its formulation to see how the antinomial syntax has been mapped into its semantical domain. Here, this calls for some background. Matter quanta, depending on observational context, display the characteristics of both particles and waves. The waves in question are not ocean-style waves of many particles, but waves of potential states of single particles. They are thus often referred to as "possibility waves". This model is usually inferred from the probabilistic formalisms necessary to describe quantum phenomena, as well as from wavelike effects observed in some kinds of quantum experiments (e.g., n-slit diffraction experiments). Of course, the analogy holds only up to a point; there may be aspects of waves and quanta which do not readily translate.

Macroscopic bodies like cats and Schrodinger boxes, because they consist of vast numbers of matter quanta, are supposedly subject to the same duality as the quanta. That is, they can be represented by wave functions defined on the wave functions of the quanta comprising them. Because quantum waves are superpositioned potentia, so are the complex waveforms of macro-bodies. So the material objects of classical physics, far from being solid and intrinsically deterministic, are ghostly apparitions in which many contradictory attributes exist at once.

Yet, when we observe such objects, they never display this kind of ambiguity: if they are here, they are here, and if they are over there, then they are there. If a cat is alive, then it is alive, and if it is dead, then it is dead. Γ_0 (physical reality) is two-valued for every attribute defined within it; there are no intervening, quasireal attributes like "here-there" or "live-dead" for observational purposes. In this sense, observation is like computation. There may be uncertainty as to what an automaton does to produce output from input, but there is no uncertainty when it comes to recognizing the output once it has been produced.

Where input-to-output transformation depends on the automaton effecting it, a given input can represent many different *potential* transforms, each to be realized by a different set of transducers. This suggests a question: given a "pre-real" stage of acceptance, why should different acceptors recognize (reify) a given input in the same way? That is, why should different observers collapse interactive quantum waves in a consistent manner? While a single wave can be collapsed only once, why should correlated *sets* of such waves not be inconsistently collapsed by the varied acceptors that intercept them? Consistency is either built into the system as a measure of observer independence (and dependency), or it is enforced by other means. But it is either the system itself, or the wider system including it, which enforces it.

It has been shown that the classical view of reality is based on three assumptions which are generally accepted without proof. The first premise, that of *realism,* holds that the patterns we observe among phenomena exist independently of our observations. The next, that of *unrestricted induction,* affirms the validity of inductive inference, whereby these patterns are imputed to causes. The third premise, *locality* (Einstein separability), holds that nothing propagates faster than light. These three "axioms" characterize certain "neoclassical" theories of quantized reality. The problem with such theories is that the data confirming quantum mechanics appear inconsistent with the given axioms, seeming to necessitate the rejection or revision of one or more of them.

Thus, quantum data seem "anomalous" with respect to theories incorporating the above premises as axioms, and a paradox exists. Technically, it was resolved by the theoretical advance from classical to quantum mechanics, which accounts for the data and thus decides the issue against neoclassicism. But the paradox persists, largely because quantum mechanics is merely probabilistic, gives only statistical predictions, and must therefore be classified as "incomplete" in the usual sense of a theory. Quantum mechanics is not giving us all the answers...and among those it is leaving out, some may bear on the relationship of the "superseded" premises in such a way as to redeem them in spirit, if not absolutely.

The desirability of such a redemption is obvious. Just imagine having to give up one of these premises unconditionally. If you reject the first, then there is no reality; there is only observation (at which point you will be forced to consider the reality of observations and those who make them, including yourself). If you reject unrestricted induction, then you keep your reality, but surrender any possibility you thought you had of understanding it. If you reject locality, you are squaring off against a pantheon of revered scientists and philosophers, including Albert Einstein and several of the fathers of quantum mechanics themselves. And many of those who now call themselves "physicists" will all but laugh you out of whatever club or journal you might have planned to use as a forum for serious consideration of your views.

The question thus arises: is there some model of reality which retains the validity of all three premises within their respective physical ranges of application? Such a model must obviously extend the classical framework within which the neoclassical paradox has been derived. This extension must not create further unresolvable paradoxes; that is, it must be constructed with "headroom" for the resolution of whatever paradoxes might be formulated within it. And it must be able to incorporate physical theories like quantum mechanics and general relativity as subformalisms. Is there, among these criteria, anything to serve as a clue in our search for the required extension?

These criteria are all computational, and computational logic is thus the means of extension. This could not possibly be plainer or more irrefutable. In the CTMU, standard *induction* has indeed been *de-restricted* to enable the stratification of *reality* in such a way that *locality* applies on the appropriate stratum. The logic is flawless. The only thing that militates against it is the idea that reality is the output phase of an incredibly huge and complex "computer". This thesis seems designed to stretch the throat of whomever tries to swallow it, and the intellectually timid will be discouraged from even making the attempt. Of course, the intellectually timid are typically not involved in any major conceptual advance, and their opinions may accordingly be dismissed.

To see why, let us sample the kind thinking that would tend to resist the CTMU extension of physical reality. *The model is too complex; such a computer as Γ would be impossible to construct or even envision. Of what would it be constructed, and by whom?* It will suffice to observe that these same criticisms can be leveled at the classical model. In fact, it can easily be shown that the classical model is equivalent to a parallel distributed "cellular" automaton! If one has an aversion to inhabiting a computer, it may reasonably be asked what he thinks he is doing by existing at all. Such a critic must either respond with an hysterical torrent of meaningless objections, or effect a rapid accumulation of mental courage. After all, it is better to exist in a logical construct than in the "vat" of a "mad scientist" - an inductive possibility mentioned in these very pages.

Where it can be shown that all roads lead to Rome, we might as well save ourselves the walk and get on a plane. The plane to catch in this case wears on its fuselage letters which read: "The wave-function collapse can be modeled as the executive phase of an instruction decoded by the meta-automaton Γ as Γ_0 output, or physical reality". This formulation is invariant with respect to the local structure of Γ, the "programming language" formulating the collapse function, or the code by which it translates as Γ_0 output-level reality; an appropriate morphism must exist. The scheduling of this collapse, as von Neumann realized, cannot be experienced beyond the range of effect. In CTMU terms, this effect equates to the first Γ_0-effective computation after propagation (i.e., the first effect of an associated Γ_0 event-causation). Very tight and tautological...but with the important qualification that the tautology is in this case a property of our innate mental structures and *their* underlying causes, and therefore terminal.

Prior to EPR/Bell nonlocality, the only restriction on the classical viewpoint involved Heisenberg uncertainty. But this was ultimately no restriction at all; one could still induce from observables whatever classical, localistic "hidden variables" one might need to explain the observations. In this case, however, it would still have been necessary to extend the observational syntax by adjunction of these variables, and this cannot be done without admitting the existence of a ***metaphysical syntax***. The "advantage" of such a "localistic" version of Γ would be the retention of the Γ_0 metric, and the elevation of the locality premise to the status of metaphysics. Some of those attracted to this advantage, using a variety of increasingly dubious arguments, still question the validity of experiments designed to confirm nonlocality. But reality must still be partitioned into that which we can know directly, and that which we can know only by effect (on the parts we can know directly). Thus, reality is tacitly relativized to syntax.

Notice what this does to the concept of wave-function collapse. By relativizing reality, we relativize the function determining the collapse of superimposed potentia *into* reality. So collapse is relativized to the criteria for reality. This means that where we insist on attributing objective reality to classical objects consisting of many quanta, the collapse of a quantum wave must occur upon the interaction of that wave with the classical object. In terms of Mr. Cole's formulation of Schrodinger's paradox, this occurs at d/v seconds after emission of the quantum wave from its source (where d is the distance in meters from emitter to detector and v is the speed of the particle in meters per second).

Because the source is not a system of radioactive atoms, but a single atom, it is not quite a classical object. But even if it were, can the loss of mass-energy associated with the radioactive decay of a single atom be considered a classical, "observable" event? If not, then the formulation leaves us in a temporary bind. Fortunately, an atom is composite enough to let its decay be rated a classical event, qualitatively different from the localistic propagation of a matter quantum through space. Even if this were not the case, however, the classical nature of the apparatus would force the classical scheduling of its state transitions.

The problem that now arises has much to do with a certain elementary philosophical paradigm: if a tree falls in the forest, but no one hears the sound of its falling, then is there a sound? Now, sound is usually considered an objective, classical physical phenomenon. Molecules - in this case, of air - are caused by the mechanical vibrations of a source to form compression waves which have objective attributes like frequency and intensity. The effects of such waves, while for the most part transient, can be mechanically amplified - or electromechanically translated by the human inner ear - into observable effects or observations.

The objective, classical point of view mandates an affirmative answer to this question on the basis of the movement of a single molecule of air, as caused by the impact of the tree against the earth. But there are other ways to view the situation. As effects defined on the pre- and post-sonic positions of gaseous molecules are virtually unmeasurable in principle - and absolutely so in the absence of a conscious attempt to measure them and read the measurement - we can, without fear of contradiction by any physical measurement, deny the effect in the absence of observation. Forget the observations of insects, snakes, and squirrels; these too are dependent for their being on the sacred act of human observation, living only for, and in, the eyes of human godlings.

This may not sound much like science, but it happens to be the view tacitly held by those quantum physicists who concur with the conventional "Copenhagen interpretation" of quantum mechanics due to the Danish physicist Niels Bohr. The etiology of this view goes something like this: the induction of causes is enabled only by determinacy. The inference of causes is thus impossible without a deterministic explanative formalism, which is not available with respect to quantum or other "indeterminate" phenomena. So these causes - or, if you like, these *mechanisms* - have no absolute determinate existence in the absehce of a deterministic formalism by which to "construct" them. So existence in general depends on the mind generating the constructive formalism. This now applies not only to indeterminate contexts but to *all* contexts, and reality - where it can be said to exist at all - is *observer-created.*

Notice that there is yet farther to go along this chain of reasoning. Any individual human being can easily adapt it to a solipsistic worldview in which nothing exists before he *personally* observes it! All things, including other so-called human beings, are nothing but the products of his observations; he "creates" them by acts of "transcendental imagination". The universe is a one-man show, a command performance by the individual consciousness for the pleasure and edification of itself. The "godling" becomes God.

We thus go from a quantum-mechanical vitiation of induction, to the dependency of reality on intelligent observation, to the sufficiency of a single intelligent observer and the superfluity of all "others". Few would deny that this gives science a whole new meaning. Unfortunately, meaning has now become indistinguishable from meaninglessness. Because science itself has warranted this reasoning, only a science of science - i.e., a metaphysics - can save it. Since all possible metaphysical schemata are required to conform to CTMU principles, the CTMU itself is the core of that metaphysics. The implications are straightforward enough.

Clearly, collapse must be relativized to the various realities of Γ-subautomata. This is no harder to comprehend than the special-relativistic symmetrization of velocities in Γ_0. Both of these relativizations have the same overall effect: they ensure the logical consistency of a complex computation, that of physical reality, in tacit accordance with principles of computational economy (efficiency, elegance). Both thus confirm the computational nature of reality, even though Einstein's contributions were made prior to the "age of computers". This is hardly astonishing, since good theories typically have places even in the advanced theories which follow them (e.g., as Newtonian physics is the "nonrelativistic limit" of relativistic physics and the "classical limit" of quantum physics). The requisite transformational symmetry is called an *empiron;* under inductive stratification, it becomes the *empyreon,* a large-scale algebraic formulation of Γ.

The computational necessity of logical consistency has direct bearing on the status of Schrodinger's poor cat. To wit, your eventual observation of its biological state, with an eye to determining whether it is dead or alive, must jibe with the "subjective", co-dependent "observations" of the apparatus, the quantum, and the cat. The differentiated existence of these realities is ensured by their inclusion in the physical stratum Γ_0 of Γ, whose connected reality is equivalent to the consistency-invariant necessarily governing multiplex observations. This consistency implies a recurring potential for theoretic incompleteness...an "incomputability" problematic to "observer-created reality". It is hard to create by observation what cannot be computed apart therefrom, particularly when one is required to create it in perfect harmony with other observations.

Where the consistency function is localistic, it can be distributed in Γ_0. Where consistency is nonlocal - as for spin conservation - the consistency function must reside in Γ "hyperspace" and act projectively. That part which is Γ_0-distributed is the guarantor that physical reality exists apart from observation; that part which is not is the guarantor that programmatic reality is similarly objective. The consistency function consists of nomological invariants in which observations are meristic; if it did not, it could not *constrain* observation in any dependable way. Observers allowed to constrain themselves autonomously in their observations of local or nonlocal physical phenomena will inevitably contradict each other; that this does not happen in irremediable ways is all the empirical evidence we need against it. The quantum-holistic interconnectedness of all observers, to whatever extent it enforces consistency among them, is *computational*... and meaningless outside the CTMU formalism.

I.e., if you admit that I exist, then I'll admit that you exist. This requires that we formulate an agreement to observe nothing in absolutely contradictory ways. The details of this agreement comprise the consistency-function of our mutual existence. This function, like any enforceable pact, must allow for the finest details of our mutual observations...the *quantum events* defining them. It follows that if you and I have mutual reality, then so do quanta, and so do the classical objects composed of them. Because they are automatonic, they have "accepting syntaxes". The mutual consistent translation of these syntaxes - the transformations of common data configurations from logical basis to logical basis - then becomes the essence of science.

Science computes theories and devices from experimentatively observed phenomena. For scientific purposes, the syntax of wavefunction collapse should therefore be that of the most powerful deterministic Γ-subautomaton definable, where "determinism" is relativized to our current scientific capabilities (these in turn being apparently limited by Heisenberg uncertainty). This is by definition Γ_0, with the finest possible deterministic quantization of space, time, and matter. This takes us directly down to the atomic level, at least with respect to the solid state physics of the Schrodinger apparatus. This implies that we can schedule wavefunction collapse by means of an atomic clock...with or without anyone watching it. So if you are not a solipsist, and if you are or aspire to be a scientist, this is your "relativized" resolution of Schrodinger's paradox. And because you are the human object of an anthropic relativization, the resolution becomes absolute.

Suppose, then, that you are so obstinate a solipsist as to yet insist that this atomic clock can only be created by your own act of mind. Then rational self-interest compels you to adopt a viewpoint tending to maximize your own power over this self-simulated pseudoreality you have "created". This reality happens to be quite a bit more comfortable than other realities you might have created for yourself. Your further satisfaction compels you to produce a reason for this, thereby to improve the quality of your daydreamt "lifestyle".

First, you notice that your dream is far too deep and complex to bring entirely under your conscious control; much of it has to be of "subconscious" origin. For one thing, the scientists and technicians who invent and operate all those pleasurable and time-saving gadgets for which you cannot produce blueprints must be tapping into your subconscious mind for their designs. It follows that the design principles, and the designers' access to them, are the means by which your subconscious has fashioned the means of your gratification. The value to you of this process is clear. It thus behooves you to allow quantum collapse to be scheduled in the way that best enhances its efficiency. But this is the same way that it should be scheduled to maximize the power of *objective* science! That is, the resolution is invariant with respect to the degree of objectivity of science or to your "degree of solipsism"; the solipsist is compelled to identify the reality of Γ with that of his own subconscious mind. So the Copenhagen interpretation is realistically pruned, and Newton defies banishment from the dream.

Of course, there are other versions of "quantum reality" than Bohr's. There is Bohm's "implicate order", which translates as the nonlocal parallel distributed computative involution of Γ, by way of empyreonic temporal operators (call it "organic" if you like, but organisms necessarily compute and must therefore answer to Γ). There is Everett's "many-worlds" interpretation, an unconstrained computative exhaustion of all possible evolutions (and subject to pruning by means of multilevel Γ-programming). There is the vague "quantum logical" perspective, which relies on Γ-universality for the relativized reification of arbitrary logics...and is thus realized as the logical structure of Γ itself. There is "neo-realism", which cannot survive Bell nonlocality without the Γ-stratification of reality. And then there is Heisenberg's conception of quasi-real "potentia" whose existence is supportable only in terms of the "pro-output phase" of Γ-functionability. All are analytic within the CTMU unification of physics and higher logic, and there only. Our results are thus impervious to objections from them.

The projectivity of our internal logic allows us to derive the potential for quantum nonlocality - an apparently "objective" concept - subjectively. This sounds fatally unscientific, but only because it is a "boundary condition" of science...a limit. By analogy, the sequence ±(finite n)/1, ±n/2, ±n/3... converges on 0, which is not the same kind of number as those in the series. Does the "unscientific" nature of projective derivation make it any less valid with respect to the process of scientific induction than the "unnumeric" aspect of 0 makes it with regard to numerical induction of the given series? Not likely. In fact, because 0 is the identity of the additive group of such numbers, they can be considered its "projections"; they exist "within it", coupled symmetrically with their additive inverses. If this seems hard to fathom, just couple 1/2 and -1/2 by addition, and see what you get. This is how the world works, to whatever extent we can reasonably hope to know it.

We project our inner reality outwardly. Our inner reality is computational, and so too is outward reality for the purposes of human observation and understanding. The attempt to separate these purposes from a higher "objective" reality has fueled the quantum-reality debate. In effect, it is asked: given that human nature and human purposes impose conditions on reality, what is reality "really" like in the absence of human beings and their designs? Unfortunately, somebody has to be asking this question, and he is probably human. He therefore requires an answer formulated within his accepting syntax...the same syntax he proposes to factor out of the picture. This, of course, is a paradox, and it necessitates a conceptual extension of the formulation. But to be humanly comprehensible, this extension must also be formulated in our native syntax! This regresses intractably, and so the above question is otiose...for our purposes. The closest we can get to a meaningful answer is the CTMU stratification of inference, and the CTMU is thus our highest possible conception of "objective reality". Try sliding out of that, and your circular slide will deliver you hard and unerringly back to your starting point...or, if you prefer, into a puddle of tar in which your intellectual movements, like the struggling of an insect in prefossilized amber, will mire you ever more hopelessly.

The universe is computation-theoretic. Notice that we are no longer calling it a "computer"; this would draw irrelevant associations out of the reader's own background, and very possibly prejudice his or her understanding. Computation theory is so general, and so powerful, that we need not at this stage restrict Γ to any particular architecture or style of computation, except by consistency with our own computational architectures. But it remains true that extended reality, and every part of it, both computes and is computed by other parts. These computative interactions are limited only by the dynamical or cognitive syntaxes - "programs" - of the appropriate subsets of extended reality, and cannot for the most part be "absolutized" except in tacit regard to them.

Time is computation. Space is computative potential. Matter computes, and parametrizes the deterministic or nondeterministic computations of other matter. Relative to position, this is just the quantized version of Mach's thesis. In it is the realization that matter has its own sort of "awareness"; to the extent that a conscious observer self-projectively creates reality, reality is consciousness. Attributes argumental to the Γ_0 localistic dynamic are, to a large extent, computed by the locally-interacting quanta themselves. It follows that wave-function collapse occurs largely on the basis of material proximity, where proximity is defined on the ranges of the elementary forces relating quanta. Macroscopic objects are systems of quanta interlocked in fieldwise computation at the appropriate distances; they are self-computing and mutually observant, and do not need to be peered at by crypto-solipsists. Observers who intend to exploit dynamical processes "in absentia" are required to reify them "in absentia". Schrodinger's cat is real, and those attributes argumental to the intrinsic (metabolic) and extrinsic Γ_0-dynamical processes involving it are computed *by* it. When the tree falls out of earshot, it thunders nonetheless.

The true nature of Schrodinger's paradox has now become clear.

The observer creates the computative observer-aspect of reality; reality computes the reality-aspect of the observer. You observe Γ, and Γ observes you back. The two sides of observation are co-dependent, and the logicomathematical formulation of codependency is *symmetry*. The relationship of an observer to objective reality, as perceived by a second observer witnessing their interaction, is thus a symmetrical relationship. The observer can create reality, and the sum of all other observers, only insofar as they create him. His limitations stratify Γ; Γ projects its stratification as that of his mind and experience. This ontological feedback is the stuff of consciousness. Consciousness is relativized to the Γ-subautomata possessing it, and is quantified according to their parameters. It is a function of unified multiplicity...the unified multiplicity of the self-differentiated telesis that is Γ.

So these are the principles needed to resolve the issue of collapse: syntax-projectivity; the computative tenor of reality; observational symmetry; and the global consistency constraint on sub-symmetric computations. These, in light of the structure of Γ as thus far described, suffice to lay the matter to rest. If there is any doubt of this, you need merely try - in your own mind - to refute one of these principles. Given enough time, and the insight of which you are capable, you will recognize the logical necessity (and even the self-evidence) of all of them.

Note that we have been discussing collapse from a physical perspective. Our resolution is thus Γ_0-relativized; it applies to the physical collapsation of physical quanta. But where collapse is more generally defined on the measurement or determination of arbitrarily-relativized random variables, it can obviously occur in different Γ-timetypes (i.e., on different Γ control-levels). Ultimately, we can speak of the *teleological phase* of collapse, tentatively identifiable with the empyreonic identity. This is the highest possible "quantum holor", whose relation to its merates is the concern of religion...a concern we are not allowed to neglect. As Kant, Newton, and Einstein knew, it is naturally the ultimate goal of any serious exploration of the nature of reality.

The theory of quantum wave-function collapse marks the crossroads of physics, philosophy, and the foundations of mathematics. If there was ever any doubt that these fields are inseparable, this is where it ends. Such doubts are the delusions of moles who tunnel until they have lost the capacity to sense anything but the minutiae just ahead of their snouts. It is therefore a point of some importance that the members of this society have demonstrated more than subterranean intelligence. A clear verification of this was offered by C. Cole, who - after circling around many of the issues essential to this discussion - expressed his feeling that the problems of nonlocality and collapse are deeply connected. We now know him to be unambiguously correct: both have computation-theoretic solutions within the CTMU formalism.

As, in principle, does everything else.

(The bibliography for the above paper is rather extensive and will therefore be omitted at this printing due to lack of space. It is in no way to be assumed that this reflects an unscientific absence of formality. Such determinations are typically made by those who face different practical constraints than the ones associated with this publication, and therefore do not apply here - Ed.)