Introduction to the CTMU

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The real universe has always been theoretically treated as an object, and specifically as the composite type of object known as a set. But an object or set exists in space and time, and reality does not. Because the real universe by definition contains all that is real, there is no "external reality" (or space, or time) in which it can exist or have been "created". We can talk about lesser regions of the real universe in such a light, but not about the real universe as a whole. Nor, for identical reasons, can we think of the universe as the sum of its parts, for these parts exist solely within a spacetime manifold identified with the whole and cannot explain the manifold itself. This rules out pluralistic explanations of reality, forcing us to seek an explanation at once monic (because nonpluralistic) and holistic (because the basic conditions for existence are embodied in the manifold, which equals the whole). Obviously, the first step towards such an explanation is to bring monism and holism into coincidence.

When theorizing about an all-inclusive reality, the first and most important principle is containment, which simply tells us what we should and should not be considering. Containment principles, already well known in cosmology, generally take the form of tautologies; e.g., "The physical universe contains all and only that which is physical." The predicate "physical", like all predicates, here corresponds to a structured set, "the physical universe" (because the universe has structure and contains objects, it is a structured set). But this usage of tautology is somewhat loose, for it technically amounts to a predicate-logical equivalent of propositional tautology called autology, meaning self-description. Specifically, the predicate physical is being defined on topological containment in the physical universe, which is tacitly defined on and descriptively contained in the predicate physical, so that the self-definition of "physical" is a two-step
operation involving both topological and descriptive containment. While this principle, which we might regard as a statement of "physicalism", is often confused with materialism on the grounds that "physical" equals "material", the material may in fact be only a part of what makes up the physical. Similarly, the physical may only be a part of what makes up the real. Because the content of reality is a matter of science as opposed to mere semantics, this issue can be resolved only by rational or empirical evidence, not by assumption alone.

Can a containment principle for the real universe be formulated by analogy with that just given for the physical universe? Let's try it: "The real universe contains all and only that which is real." Again, we have a tautology, or more accurately an autology, which defines the real on inclusion in the real universe, which is itself defined on the predicate real. This reflects semantic duality, a logical equation of predication and inclusion whereby perceiving or semantically predicing an attribute of an object amounts to perceiving or predicating the object's topological inclusion in the set or space dualistically corresponding to the predicate. According to semantic duality, the predication of the attribute real on the real universe from within the real universe makes reality a self-defining predicate, which is analogous to a self-including set. An all-inclusive set, which is by definition self-inclusive as well, is called "the set of all sets". Because it is all-descriptive as well as self-descriptive, the reality predicate corresponds to the set of all sets. And because the self-definition of reality involves both descriptive and topological containment, it is a two-stage hybrid of universal autology and the set of all sets.

Now for a brief word on sets. Mathematicians view set theory as fundamental. Anything can be considered an object, even a space or a process, and wherever there are objects, there is a set to contain them. This "something" may be a relation, a space or an algebraic system, but it is also a set; its relational, spatial or algebraic structure simply makes it a structured set. So mathematicians view sets, broadly including null, singleton, finite and infinite sets, as fundamental objects basic to meaningful descriptions of reality. It follows that reality itself should be a set...in fact, the largest set of all. But every set, even the largest one, has a powerset which contains it, and that which contains it must be larger (a contradiction). The obvious solution: define an extension of set theory incorporating two senses of "containment" which work together in such a way that the largest set can be defined as "containing" its
powerset in one sense while being contained by its powerset in the other. Thus, it topologically includes itself in the act of descriptively including itself in the act of topologically including itself..., and so on, in the course of which it obviously becomes more than just a set.

In the Cognitive-Theoretic Model of the Universe or CTMU, the set of all sets, and the real universe to which it corresponds, take the name (SCSPL) of the required extension of set theory. SCSPL, which stands for Self-Configuring Self-Processing Language, is just a totally intrinsic, i.e. completely self-contained, language that is comprehensively and coherently (self-distributively) self-descriptive, and can thus be model-theoretically identified as its own universe or referent domain. Theory and object go by the same name because unlike conventional ZF or NBG set theory, SCSPL holoically infuses sets and their elements with the distributed (syntactic, metalogical) component of the theoretical framework containing and governing them, namely SCSPL syntax itself, replacing ordinary set-theoretic objects with SCSPL syntactic operators. The CTMU is so-named because the SCSPL universe, like the set of all sets, distributively embodies the logical syntax of its own descriptive mathematical language. It is thus not only self-descriptive in nature; where logic denotes the rules of cognition (reasoning, inference), it is self-cognitive as well. (The terms "SCSPL" and "hology" are explained further below; to skip immediately to the explanations, just click on the above links.)

An act is a temporal process, and self-inclusion is a spatial relation. The act of self-inclusion is thus "where time becomes space"; for the set of all sets, there can be no more fundamental process. No matter what else happens in the evolving universe, it must be temporally embedded in this dualistic self-inclusion operation. In the CTMU, the self-inclusion process is known as conspansion and occurs at the distributed, Lorentz-invariant conspansion rate c, a time-space conversion factor already familiar as the speed of light in vacuo (conspansion consists of two alternative phases accounting for the wave and particle properties of matter and affording a logical explanation for accelerating cosmic expansion). When we imagine a dynamic self-including set, we think of a set growing larger and larger in order to engulf itself from without. But since there is no "without" relative to the real universe, external growth or reference is not an option; there can be no external set or external descriptor. Instead, self-inclusion and self-description must occur inwardly as the universe
stratifies into a temporal sequence of states, each state topologically and computationally contained in the one preceding it (where the conventionally limited term computation is understood to refer to a more powerful SCSPL-based concept, protocomputation, involving spatiotemporal parallelism). On the present level of discourse, this inward self-inclusion is the conspansive basis of what we call spacetime.

Every object in spacetime includes the entirety of spacetime as a state-transition syntax according to which its next state is created. This guarantees the mutual consistency of states and the overall unity of the dynamic entity the real universe. And because the sole real interpretation of the set-theoretic entity "the set of all sets" is the entire real universe, the associated foundational paradoxes are resolved in kind (by attributing mathematical structure like that of the universe to the pure, uninterpreted set-theoretic version of the set of all sets). Concisely, resolving the set-of-all-sets paradox requires that (1) an endomorphism or self-similarity mapping \( D : S \rightarrow rI S \) be defined for the set of all sets \( S \) and its internal points \( r \); (2) there exist two complementary senses of inclusion, one topological \( [S \mathcal{E}_t D(S)] \) and one predicative \( [D(S) \mathcal{E}_d S] \), that allow the set to descriptively "include itself" from within, i.e. from a state of topological self-inclusion (where \( \mathcal{E}_t \) denotes topological or set-theoretic inclusion and \( \mathcal{E}_d \) denotes descriptive inclusion, e.g. the inclusion in a language of its referents); and (3) the input \( S \) of \( D \) be global and structural, while the output \( D(S) = (r \mathcal{E}_d S) \) be internal to \( S \) and play a syntactic role. In short, the set-theoretic and cosmological embodiments of the self-inclusion paradox are resolved by properly relating the self-inclusive object to the descriptive syntax in terms of which it is necessarily expressed, thus effecting true self-containment: "the universe (set of all sets) is that which topologically contains that which descriptively contains the universe (set of all sets)."

This characterizes a system that consistently perceives itself and develops its own structure from within via hology, a 2-stage form of self-similarity roughly analogous to holography. (Hology is a logico-cybernetic form of self-similarity in which the global structure of a self-contained, self-interactive system doubles as its distributed self-transductive syntax; it is justified by the obvious fact that in a self-contained system, no other structure is available for that purpose.) The associated conspansive mapping \( D \) is called incovation in the spatiotemporally inward direction and coinversion in the reverse (outward, \( D^{-1} \)) direction.
Incoversion carries global structure inward as state-recognition and state-transformation syntax, while coinversion projects syntactic structure outward in such a way as to recognize existing structure and determine future states in conformance with it. Incoversion is associated with an operation called *requantization*, while coinversion is associated with a complementary operation called *inner expansion*. The alternation of these operations, often referred to as *wave-particle duality*, comprises the conspansion process. The **Principle of Conspsansive Duality** then says that what appears as cosmic expansion from an interior (local) viewpoint appears as material and temporal contraction from a global viewpoint. Because metric concepts like "size" and "duration" are undefined with respect to the universe as a whole, the spacetime metric is defined strictly intrinsically, and the usual limit of cosmological regress, a pointlike cosmic singularity, becomes the closed spacetime algebra already identified as SCSPL.

Thus, the real universe is not a static set, but a dynamic process resolving the self-inclusion paradox. Equivalently, because any real explanation of reality is contained in reality itself, reality gives rise to a paradox unless regarded as an inclusory self-mapping. This is why, for example, category theory is increasingly preferred to set theory as a means of addressing the foundations of mathematics; it centers on invariant relations or mappings between covariant or contravariant (dually related) objects rather than on static objects themselves. For similar reasons, a focus on the relative invariants of semantic processes is also well-suited to the formulation of evolving theories in which the definitions of objects and sets are subject to change; thus, we can speak of *time and space* as equivalent to *cognition and information* with respect to the invariant semantic relation processes, as in "time processes space" and "cognition processes information". But when we define reality as a process, we must reformulate containment accordingly. Concisely, reality theory becomes a study of SCSPL autology naturally formulated in terms of mappings. This is done by adjoining to logic certain metalogical principles, formulated in terms of mappings, that enable reality to be described as an autological (self-descriptive, self-recognizing/self-processing) system.

The first such principle is **MAP**, acronymic for *Metaphysical Autology Principle*. Let S be the real universe, and let T = T(S) be its theoretical description or "TOE". MAP, designed to endow T and S with mathematical
closure, simply states that T and S are closed with respect to all internally relevant operations, including recognition and description. In terms of mappings, this means that all inclusional or descriptive mappings of S are automorphisms (e.g., permutations or foldings) or endomorphisms (self-injections). MAP is implied by the unlimited scope, up to perceptual relevance, of the universal quantifier implicitly attached to reality by the containment principle. With closure thereby established, we can apply techniques of logical reduction to S without worrying about whether the lack of some external necessity will spoil the reduction. In effect, MAP makes T(S) "exclusive enough" to describe S by excluding as a descriptor of S anything not in S. But there still remains the necessity of providing S with a mechanism of self-description.

This mechanism is provided by another metalogical principle, the M=R or Mind Equals Reality Principle, that identifies S with the extended cognitive syntax D(S) of the theorist. This syntax (system of cognitive rules) not only determines the theorist's perception of the universe, but bounds his cognitive processes and is ultimately the limit of his theorization (this relates to the observation that all we can directly know of reality are our perceptions of it). The reasoning is simple; S determines the composition and behavior of objects (or subsystems) s in S, and thus comprises the general syntax (structural and functional rules of S) of which s obeys a specific restriction. Thus, where s is an ideal observer/theorist in S, S is the syntax of its own observation and explanation by s. This is directly analogous to "the real universe contains all and only that which is real", but differently stated: "S contains all and only objects s whose extended syntax is isomorphic to S." M=R identifies S with the veridical limit of any partial theory T of S [limT(S) = D(S)], thus making S "inclusive enough" to describe itself. That is, nothing relevant to S is excluded from S @ D(S).

Mathematically, the M=R Principle is expressed as follows. The universe obviously has a structure S. According to the logic outlined above, this structure is self-similar; S distributes over S, where "distributes over S" means "exists without constraint on location or scale within S". In other words, the universe is a perfectly self-similar system whose overall structure is replicated everywhere within it as a general state-recognition and state-transition syntax (as understood in an extended computational sense). The self-distribution of S, called hology, follows from the containment principle, i.e. the tautological fact
that everything within the real universe must be described by the predicate "real" and thus fall within the constraints of global structure. That this structure is completely self-distributed implies that it is locally indistinguishable for subsystems $s$; it could only be discerned against its absence, and it is nowhere absent in $S$. Spacetime is thus transparent from within, its syntactic structure invisible to its contents on the classical (macroscopic) level. Localized systems generally express and utilize only a part of this syntax on any given scale, as determined by their specific structures. I.e., where there exists a hological incoersion endomorphism $D:S\rightarrow rI\rightarrow S$ carrying the whole structure of $S$ into every internal point and region of $S$, objects (quantum-geometrodynamically) embedded in $S$ take their recognition and state-transformation syntaxes directly from the ambient spatiotemporal background up to isomorphism. Objects thus utilize only those aspects of $D(S)$ of which they are structural and functional representations.

The inverse $D^{-1}$ of this map (coinversion) describes how an arbitrary local system $s$ within $S$ recognizes $S$ at the object level and obeys the appropriate "laws", ultimately giving rise to human perception. This reflects the fact that $S$ is a self-perceptual system, with various levels of self-perception emerging within interactive subsystems $s$ (where perception is just a refined form of interaction based on recognition in an extended computational sense). Thus, with respect to any class $\{s\}$ of subsystems of $S$, we can define a homomorphic submap $d$ of the endomorphism $D$: $d:S\rightarrow \{s\}$ expressing only that part of $D$ to which $\{s\}$ is isomorphic. In general, the $s_i$ are coherent or physically self-interactive systems exhibiting dynamical and informational closure; they have sometimes-inaccessible internal structures and dynamics (particularly on the quantum scale), and are distinguishable from each other by means of informational boundaries contained in syntax and comprising a "spacetime metric".

According to the above definitions, the global self-perceptor $S$ is amenable to a theological interpretation, and its contents $\{s\}$ to "generalized cognitors" including subatomic particles, sentient organisms, and every material system in between. Unfortunately, above the object level, the validity of $s$-cognition - the internal processing of sentient subsystems $s$ - depends on the specific cognitive functionality of a given $s$...the extent to which $s$ can implicitly represent higher-order relations of $S$. In General Relativity, $S$ is regarded as given and
complete; the laws of mathematics and science are taken as pre-existing. On the quantum scale, on the other hand, laws governing the states and distributions of matter and energy do not always have sufficient powers of restriction to fully determine quantum behavior, requiring probabilistic augmentation in the course of quantum wavefunction collapse. This prevents a given $s$, indeed anything other than $S$, from enclosing a complete nomology (set of laws); while a complete set of laws would amount to a complete deterministic history of the universe, calling the universe "completely deterministic" amounts to asserting the existence of prior determinative constraints. But this is a logical absurdity, since if these constraints were real, they would be included in reality rather than prior or external to it (by the containment principle). It follows that the universe freely determines its own constraints, the establishment of nomology and the creation of its physical (observable) content being effectively simultaneous and recursive. The incoversive distribution of this relationship is the basis of free will, by virtue of which the universe is freely created by sentient agents existing within it.

Let’s elaborate a bit. Consider the universe as a completely evolved perceptual system, including all of the perceptions that will ultimately comprise it. We cannot know all of those perceptions specifically, but to the extent that they are interactively connected, we can refer to them en masse. The set of "laws" obeyed by the universe is just a minimal set of logical relations that suffices to make these perceptions noncontradictory, i.e. mutually consistent, and a distributed set of laws is just a set of laws formulated in such a way that the formulation can be read by any part of the system $S$. Obviously, for perceptions to be connected by laws, the laws themselves must be internally connected according to a syntax, and the ultimate syntax of nomological connectedness must be globally valid; whatever the laws may be at any stage of system evolution, all parts of $S$ must be able to unambiguously read them, execute and be acted upon by them, and recognize and be recognized as their referents ("unambiguously" implies that 2-valued logic is a primary ingredient of nomology; its involvement is described by a third metalogical principle designed to ensure consistency, namely MU or Multiplex Unity). This implies that the action and content of the laws are merged together in each part of the system as a single (but dual-aspect) quantity, infocognition. The connectedness and consistency of infocognition is maintained by refinement
and homogenization as nomological languages are superseded by extensional metalanguages in order to create and/or explain new data; because the "theory" SCSPL model-theoretically equates itself to the real universe, its "creation" and causal "explanation" operations are to a certain extent identical, and the SCSPL universe can be considered to create or configure itself by means of "self-theorization" or "self-explanation".

The simplest way to explain "connected" in this context is that every part of the (object-level) system relates to other parts within an overall structural description of the system itself (to interpret "parts", think of events rather than objects; objects are in a sense defined on events in a spatiotemporal setting). Obviously, any part which fails to meet this criterion does not conform to a description of the system and thus is not included in it, i.e. not "connected to" the system (on the other hand, if we were to insist that it is included or connected, then we would have to modify the systemic description accordingly). For this description to be utile, it should be maximally compact, employing compact predictive generalizations in a regular way appropriate to structural categories (e.g., employing general "laws of physics"). Because such laws, when formulated in an "if conditions (a,b,c…) exist, then (X and Y or Z) applies" way, encode the structure of the entire system and are universally applicable within it, the system is "self-distributed". In other words, every part of the system can consistently interact with every other part while maintaining an integral identity according to this ("TOE") formulation. Spatiotemporal relations can be skeletally depicted as edges in a graph whose vertices are events (physical interactions), i.e. spacetime "points". In this sense, graph-theoretic connectivity applies. But all those object-level connections must themselves be connected by more basic connections, the basic connections must be connected by even more basic connections, and so on. Eventually - perhaps sooner than later - we reach a basic level of connectivity whose syntax comprises a (partially undecidable) "ultimate nomology" for the level of reality we're discussing.

Is this nomology, and the cognitive syntax in which it is expressed, wholly embodied by matter? In one sense the answer is yes, because S is distributed over each and every material sÎS as the reality-syntax D(S). Thus, every axiom and theorem of mathematics can be considered implicit in material syntax and potentially exemplified by an appropriate material pattern, e.g. a firing of cerebral neurons. Against holism - the idea that the universe is more than the
sum of its parts - one can further object that the holistic entity in question is still a material ensemble, thus insinuating that even if the universe is not the "sum" of its parts, it is still a determinate function of its parts. However, this fails to explain the mutual consistency of object-syntaxes, without the enforcement of which reality would disintegrate due to perceptual inconsistency. This enforcement function takes matter as its argument and must therefore be reposed in spacetime itself, the universal substrate in which matter is unconditionally embedded (and as a geometrodynamic or quantum-mechanical excitation of which matter is explained). So the background has logical ascendancy over derivative matter, and this permits it to have aspects, like the power to enforce consistency, not expressible by localized interactions of compact material objects (i.e., within the bounds of materialism as invoked regarding a putative lack of "material evidence" for God, excluding the entire material universe).

On the other hand, might cognitive syntax reside in an external "ideal" realm analogous to Plato’s world of Parmenidean forms? Plato’s ideal abstract reality is explicitly set apart from actual concrete reality, the former being an eternal world of pure form and light, and the latter consisting of a cave on whose dirty walls shift murky, contaminated shadows of the ideal world above. However, if they are both separate and in mutual correspondence, these two realities both occupy a more basic joint reality enforcing the correspondence and providing the metric of separation. If this more basic reality is then juxtaposed to another, then there must be a more basic reality still, and so on until finally we reach the most basic level of all. At this level, there will (by definition) be no separation between the abstract and concrete phases, because there will be no more basic reality to provide it or enforce a remote correspondence across it. This is the inevitable logical terminus of "Plato’s regress". But it is also the reality specified by the containment principle, the scope of whose universal quantifier is unlimited up to perceptual relevance! Since it is absurd to adopt a hypothesis whose natural logical extension is a negation of that hypothesis, we must assume that the ideal plane coincides with this one...but again, not in a way necessarily accessible to identifiable physical operations. Rather, physical reality is embedded in a more general or "abstract" ideal reality equating to the reality-syntax D(S), and the syntax D(S) is in turn embedded in physical reality by incoversion. Thus, if D(S) contains supraphysical components, they are embedded in S right along with their
physical counterparts (indeed, this convention is already in restricted use in string theory and M-theory, where unseen higher dimensions get "rolled up" to sub-Planck diameter).

What does this say about God? First, if God is real, then God inheres in the comprehensive reality syntax, and this syntax inheres in matter. Ergo, God inheres in matter, and indeed in its spacetime substrate as defined on material and supramaterial levels. This amounts to pantheism, the thesis that God is omnipresent with respect to the material universe. Now, if the universe were pluralistic or reducible to its parts, this would make God, Who coincides with the universe itself, a pluralistic entity with no internal cohesion. But because the mutual syntactic consistency of parts is enforced by a unitary holistic manifold with logical ascendancy over the parts themselves - because the universe is a dual-aspected monic entity consisting of essentially homogeneous, self-consistent infocognition - God retains monotheistic unity despite being distributed over reality at large. Thus, we have a new kind of theology that might be called monopanthism, or even more descriptively, holopanthism. Second, God is indeed real, for a coherent entity identified with a self-perceptual universe is self-perceptual in nature, and this endows it with various levels of self-awareness and sentience, or constructive, creative intelligence. Indeed, without a guiding Entity whose Self-awareness equates to the coherence of self-perceptual spacetime, a self-perceptual universe could not coherently self-configure. Holopanthism is the logical, metatheological umbrella beneath which the great religions of mankind are unknowingly situated.

Why, if there exists a spiritual metalanguage in which to establish the brotherhood of man through the unity of sentience, are men perpetually at each others’ throats? Unfortunately, most human brains, which comprise a particular highly-evolved subset of the set of all reality-subsystems, do not fire in strict S-isomorphism much above the object level. Where we define one aspect of "intelligence" as the amount of global structure functionally represented by a given sÎS, brains of low intelligence are generally out of accord with the global syntax D(S). This limits their capacity to form true representations of S (global reality) by syntactic autology \[d(S) \not\equiv d(S)\] and make rational ethical calculations. In this sense, the vast majority of men are not well-enough equipped, conceptually speaking, to form perfectly rational worldviews and
societies; they are deficient in education and intellect, albeit remediably so in most cases. This is why force has ruled in the world of man...why might has always made right, despite its marked tendency to violate the optimization of global utility derived by summing over the sentient agents of S with respect to space and time.

Now, in the course of employing deadly force to rule their fellows, the very worst element of humanity – the butchers, the violators, i.e. those of whom some modern leaders and politicians are merely slightly-chastened copies – began to consider ways of maintaining power. They lit on religion, an authoritarian priesthood of which can be used to set the minds and actions of a populace for or against any given aspect of the political status quo. Others, jealous of the power thereby consolidated, began to use religion to gather their own "sheep", promising special entitlements to those who would join them...mutually conflicting promises now setting the promisees at each other’s throats.

But although religion has often been employed for evil by cynics appreciative of its power, several things bear notice. (1) The abuse of religion, and the God concept, has always been driven by human politics, and no one is justified in blaming the God concept, whether or not they hold it to be real, for the abuses committed by evil men in its name. Abusus non tollit usum. (2) A religion must provide at least emotional utility for its believers, and any religion that stands the test of time has obviously been doing so. (3) A credible religion must contain elements of truth and undecidability, but no elements that are verifiably false (for that could be used to overthrow the religion and its sponsors). So by design, religious beliefs generally cannot be refuted by rational or empirical means.

Does the reverse apply? Can a denial of God be refuted by rational or empirical means? The short answer is yes; the refutation follows the reasoning outlined above. That is, the above reasoning constitutes not just a logical framework for reality theory, but the outline of a logical proof of God's existence and the basis of a "logical theology". While the framework serves other useful purposes as well, e.g. the analysis of mind and consciousness, we'll save those for another time.