A Rational Cosmology

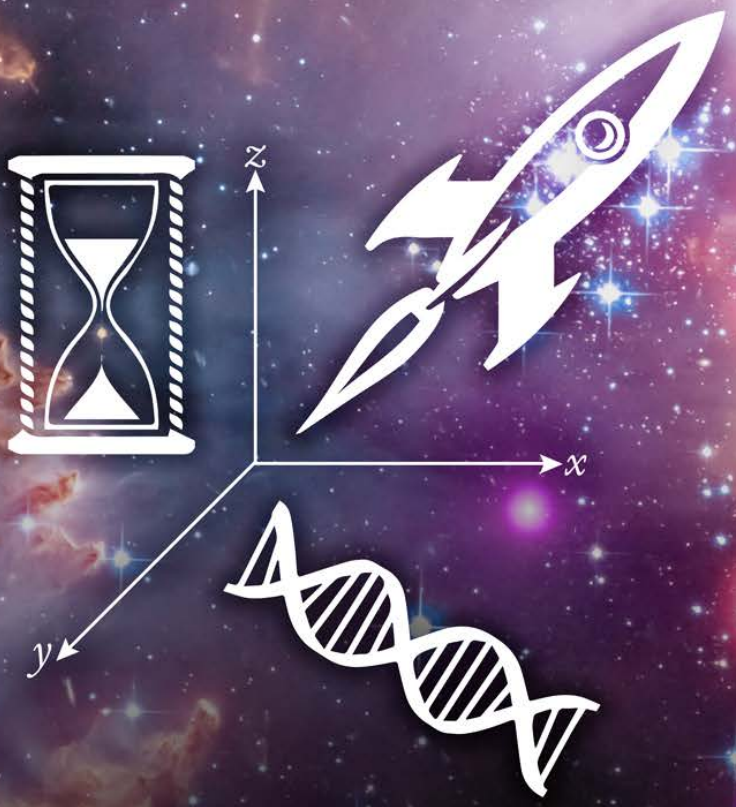

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Table of Contents

Chapter I
The Axiomatic, Ubiquitous, and Commonsense

The Errors of Empiricism-Positivism

Essay I

Contemporary science is often prevented from further progress by a fallacy which forms a glaring breach between its findings and the conclusions and observations ubiquitously available to any man whose five senses function properly.

This fallacy is not as blatant as the superstitions of old. It is not a belief in witches or cosmic spirits, but rather a new form of denying the evidence of man's most common faculties. It has been nurtured by a long line of philosophers, but its greatest emergence was seen during the twentieth century, a time when science often succumbed to subjectivism, unverifiable theorizing, the dominance of "intuition," groupthink, and ultra-specialization which detached scientists from any findings or interactions outside their bizarrely narrow fields.

This superstition can be called many names, but its most comprehensive, and the one that shall be used throughout this treatise, is *empiricism-positivism.*

Empiricism-positivism is not the same as reliance on empirical observation or evidence. It is not the same as empiricism *per se*, a philosophical strain that emerged in the 17th century and was fortified in the 18th century. The empiricist wing of the Enlightenment – comprised of thinkers such as Francis Bacon, John Locke, and David Hume – made considerable contributions to the advancement of science and philosophy as humankind was emerging from a dark, theocratic, dogmatic era. These empiricist thinkers were not always right (Hume's "is-ought" dichotomy is a good example of some pitfalls of early empiricism), but they did make strides forward in terms of rendering reality more *knowable and explicable* through the use of systematic observation of the external world and logical derivations from such observation. Empiricism of this sort made valuable contributions to the scientific method as it can be and ought to be practiced.

Empiricism-positivism is a more recent doctrine that, unlike the earlier empiricism, limits the scope of possible human knowledge instead of broadening it. One of its first progenitors was the originator of the term "positivism", Auguste Comte, who lived from 1794 to 1859. The logical positivist movement in Berlin and Vienna during the 1920s and 1930s further formalized this doctrine, rejecting as meaningless or "unscientific" any sort of metaphysics or ethics in philosophy or any sort of certainty in universal knowledge derived from the everyday human observation of reality.

Very mildly put, today's empiricism-positivism holds, as its fundamental tenet, that *any assertion, no matter how general, depends on some single particular observation or some specific set of particular observations.* The empiricist-positivist will claim that one cannot make any conclusions about space or time without first studying advanced quantum mechanics. He will claim that one cannot make any generalizations about human nature independent of the historical context of any given time period.

As a corollary to this inseparable attachment of empiricism-positivism to some specific observations, this doctrine holds that *man cannot be certain about anything,* since, because all conclusions depend on specific observations, some future observation always has the chance of refuting one's present appraisal of *anything whatsoever!*

But what will the empiricist-positivist say to the man who dares proclaim, "I exist!"? Is this a statement contingent on further observations? Can some further piece of evidence come along during that man's lifetime which can disprove his assertion?

What about another basic proposition: "Existence exists!"? Can some new twist of quantum mechanics or ultra-microscopy refute that?

It is clear that, to base science, the quest for *knowledge,* on a doctrine that postulates man's perpetual ignorance and uncertainty, is a clear contradiction that fundamentally undermines the very purpose of science. The result is the unfortunately far-too-limited state of many of today's scientific branches. They can do so much more; they can open doors into massive improvements in human well-being, derived from the harnessing of the laws of nature; they can explore and harness the interrelationships among all fields of human knowledge, since all knowledge is knowledge of the same reality. But many scientists do not venture there, largely due to institutional and societal discouragement. With emerging exceptions from pioneering scientists who dare to challenge convention, mainstream academic explorations remain confined to what is deemed acceptable within the empiricist-positivist orthodoxy of our time. People who propose new approaches are too often ignored at best, and sometimes derided and vilified. An academic protectionism has emerged, where adherence to the reigning theories, paradigms, and views of the world is seen as the only way to get ahead, and entry into the realm of discussion by creative outsiders is discouraged.

To be clear, observation is *critical* to scientific progress; no man's mind can operate in a vacuum. Man's inherent capacity for rational thought is useless unless he has *something to think about.* However, true science, as a quest to systematize human knowledge, must depend on *all* observations, not just the esoteric or highly particular ones. In order to overcome the errors of empiricism-positivism, it is necessary to recognize that besides particular observations, there exist *ubiquitous observations* that any man can grasp and use to better understand reality.

The Axioms of Existence, Identity, and Consciousness

Essay II

There exist certain conclusions that are available to all men, no matter what their age, intellect, or degree of scientific expertise. Nor does it matter *what particular objects* these men observe when they make these conclusions, as such conclusions do not entail *one or several particular observations.* Rather, they entail *the capacity to make any observations whatsoever,* and are verified whenever one makes *any observation.* These propositions are what are often termed "common sense," a fitting description, as they are derived from those things that all human beings can sense, from observations common to all of us.

At the root of such propositions lie the *axioms.*

An axiom is a self-verifying statement. It cannot be proved deductively, because it is, in itself, the foundation upon which all further proofs are built. Nevertheless, no matter what one says, sees, or does, such speech, observation, or action will verify the axioms. Philosopher Ayn Rand identified three fundamental axioms which are inextricably attached to each other, and are demonstrated unceasingly in everything that exists:

1. **Existence –** Something *is.* If no thing existed, nothing could be observed!
2. **Identity –** *Something* is. Whatever is, is something in particular, i.e., has a certain definite nature.
3. **Consciousness –** We can perceive what is. The observer exists and so does the faculty by which he perceives what exists.

Even in the attempt to deny them, these axioms will hold. If one stated, "existence does not exist," it would be a matter of great wonder how one could make such a claim, being a part of existence as one is.

Moreover, how can existence not have the property which it has – that is, the property of existing? (Saying, "Existence does not exist" is tantamount to saying "That which has the essential property of existing does not have the essential property of existing.")

If one stated, "nothing has any identity," this would bring up the question, "Why did one use the word 'nothing,' which really means, '*no thing?'* If there is no such thing as identity, then, what is a *thing?*" If one stated, "Consciousness does not exist," the speaker would need to not exist in order for such an assertion to be true. After all, such a statement *did* spring from his consciousness!

Since even the attempt to refute them in fact confirms their truth, the axioms of existence, identity, and consciousness can be recognized as certain and serve as a foundation from which further basic knowledge about existence is arrived at and evaluated. In order to be considered true, any other proposition must be in accord with the three fundamental axioms.

The Natures and Tasks of Ontology and Cosmology

Essay III

The branch of philosophy that deals with existence at its most fundamental level is termed *metaphysics.* The branch of metaphysics that concerns *the nature of what exists* is termed *ontology*.

Ontology makes the distinction between *entities*, the things that exist, and *qualities,* the attributes that these things have. The philosopher Reginald Firehammer states three fundamental ontological corollaries to the axiom of identity in his essay, "Perception." The ontological corollaries answer the question: "What is an entity?"

• The **first corollary of identity**: *Anything that exists must have some qualities.*
• The **second corollary of identity**: *Anything that exists must be different in some way from everything else that exists and have some quality or combination of qualities no other existent has.*
• The **third corollary of identity**: *Anything that exists must have some relationship to everything else that exists.*

A *quality,* on the other hand, is not a *thing* or an *entity* in its own right. Rather, it cannot conceivably exist except as an attribute of the entities that exhibit it. For example, there is no such *thing* as "the color red". The color red cannot be imagined to exist outside of those *things* which are red: red paint, red letters, red furniture, red vegetables, etc. There cannot be a "pure quality" apart from the entities that possess it.

Ontology is the branch of metaphysics that focuses on what entities and qualities *are,* how to distinguish between them, and how to categorize relationships between and among entities, as well as the various *states* under which various entities and their relationships may be classified. Within this work, it will be my task to develop ontology to a level necessitated by the discussion of a branch of metaphysics which is derivative from ontology – namely, *cosmology.*

While ontology concerns itself with the general nature of entities, qualities, and relationships, cosmology ventures even further, by making certain *fundamental empirical assertions about existence.* Ontology deals with the *conceptual underpinnings of all existence,* whereas cosmology deals with the *observational underpinnings thereof.*

For many years, cosmology has been misclassified as a "natural science" or, worse, a branch of physics, rendering it fashionable for such scientists as Stephen Hawking to offer speculations about space, time, and the universe which are in fact the province of philosophy, not physics, to explicate. Hawking's specific conclusions are sometimes right, but he is thoroughly wrong to dismiss the value of philosophy in resolving questions about the natural world. Now, however, an alternative view, based on reason, common sense, and the observations humans make every moment of the world around them, can supplant the false cosmology of contemporary physicists.

The Distinction between Physics and Cosmology

Essay IV

The reason for cosmology's essential grounding in ontology is the fact that, before one can answer questions such as "What entities exist?", "What qualities exist?", and "What relationships exist?", one must first answer the questions: "What is an entity?", "What is a quality?", and "What is a relationship?"

This, of course, implies, that all true and objective science is in fact founded upon a rational ontology, metaphysics, and (more generally) philosophy. Both philosophy and physics are sciences, but philosophy is a *foundational science,* and physics is a *specific-observational science.*

I use the term "specific-observational" as distinguished from "general-observational", which would be the basis for such sciences as philosophy and mathematics. There is no true science which does not have *some* kind of observation behind it, but this does not have to be observation under the narrow empiricist-positivist definition which equates observation with experimentation.

Physics (along with the other "natural" or specific-observational sciences) seeks to answer the question: "What are particular entities/qualities/relationships?" This therefore renders it dependent on specific, targeted observations of those entities/qualities/relationships.

Cosmology, on the other hand, is *not* derivative of physics, but rather far more fundamental, as it depends on general, not specific, observations. It asks: "What entities/qualities/relationships exist *universally*, and are ubiquitously observable?"

The detailed study of cats and dogs is beyond cosmology (they are studied by biology), because there is the possibility that a given man, in a given setting, will never encounter cats or dogs. Cosmology can only say that cats and dogs are "entities."

But what is meant by "space," "time," "universe," "shape," "color," "light," "matter," "dimension," and numerous other commonly used terms, cannot be escaped in any environment. Every man will have need of using such terms to describe the world he observes, and the task of cosmology is to discover *what* such terms *actually refer to*!

Cosmology can be quite useful in identifying and discarding erroneous or unwarranted statements made by contemporary scientists, when they venture outside their field of categorizing and explaining specific observations and phenomena, and into making generalizations of a metaphysical scope about the nature of some of the aforementioned terms.

It is perfectly within the scope of physics to discuss the behaviors of subatomic particles inaccessible to the unequipped eye, or to discover that the relationship "sound" is made manifest in wavelike phenomena. Physics, however, can never rationally venture to state that a particle is

not an entity, or that a sound is not a relationship. That is the province of cosmology as a branch of philosophy.

To summarize: the specific-observational sciences can tell us *the mechanisms* involved in particular entities, qualities, or relationships. They cannot, however, tell us whether or not something is an entity, a quality, or a relationship (or neither of the three, for that matter, as shall be seen in later examples). That is the province of cosmology.

Chapter II
The Universe

What the Universe Is and Is Not

Essay V

From its ancient Greek roots, the word "cosmology" means, "study of the universe." This is an extremely broad and fundamental designation, as cosmology is, indeed, extremely broad and fundamental. Cosmology is too broad and fundamental, for that matter, to be categorized as a mere branch of physics. Yet what is meant by this term: "cosmos" or "universe"? What is it exactly that cosmology studies?

"Universe" means "everything that exists".

The word "universe" derives from the Latin *universum*, meaning "the whole world" – that is, "everything". The term "universe" does not denote an *entity*, however. It is the *sum* of all entities that exist. It is *not* a "whole" in the sense that a person, a planet, or a star is a "whole".

As a matter of fact, it would be absurd to state that Chicago, Quasimodo, a telescope, and a hippopotamus compose some inextricably whole entity. It follows that it would be even more absurd to state that Chicago, Quasimodo, a telescope, a hippopotamus, *and everything else* compose some inextricably whole entity. Nevertheless, it seems that, the more absurd a notion is, the greater credibility it has in the eyes of certain contemporary empiricist-positivist cosmologists, who constantly refer to the universe as if it were some totality acting in unison.

Nor is the universe a quality. I cannot have "universe" in the same manner as I have color, or shape, or mass. Nevertheless, the term "universe" pertains to me as it pertains to everything else that exists. It *encompasses* me and everything else that exists.

Nor is the universe a relationship. A relationship is an interaction between or among several entities that affects, in some manner, the qualities of these entities. Yet the term "universe" implies no actions by any entity. It merely denotes the totality of all the entities that exist, whatever their specific natures. These specific natures could necessitate that given entities act

and relate in a certain way, but the universe is not in *itself* an action or relation. It is just a reference to the entirety of those entities which act and relate in some way.

What, then, is the purpose of the term "universe"? If it denotes neither entity, nor quality, nor relationship, why does the term even exist? "Universe" is a *collective designation,* and is used for one purpose and one purpose only: *word economy.* The word "universe" is interchangeable with "existence" or "everything that exists".

When one wishes to refer to axioms, principles, and postulates that pertain to everything that exists, it would be terribly inconvenient to start listing each entity that can possibly exist: "Chicago, Quasimodo, a telescope, a hippopotamus, etc., all confirm the axiom of identity."

Thus, the term "universe" is just convenient shorthand for a comprehensive list of all these entities. Given that there are colossally vast quantities of such entities, no man could even begin to create a comprehensive compendium of them within his whole lifetime, no matter how long he lives.

Hence, the convenient shorthand of the term "universe" is necessary in order for a human to even begin to convey what precisely he or she is talking about. Moreover, the term offers added conveniences, such as being transformable into an adjective – "universal" – which means "pertaining to everything that exists" (as in "universal laws," for example).

Several immense implications can be drawn from this analysis, which we shall explore as *A Rational Cosmology* unfolds.

The Universe Cannot Be Created

Essay VI

In Essay V, I defined the universe as "everything that exists" – a convenient shorthand for every entity that is.

If it is true that the universe is "everything that exists," and it could be created, then, whatever entity could create the universe, would be outside that universe. It follows, then, that such an entity would be outside "everything that exists". An entity "outside" existence *does not exist*! A non-existent entity cannot do anything. Creation is an action that an entity must perform; it cannot be performed if the entity that would perform it does not exist!

It is instructive to note that this principle automatically refutes *both* the theory that "God created the universe," as will be shown here, and that "the Big Bang created the universe," as will be shown subsequently.

Even if it were possible that all currently known entities were intelligently designed, they could not have been designed by a being that is somehow "beyond existence".

Rather, this being would need to be a delimited entity in its own right, with its own peculiar attributes (qualities) and capacities for action (relationships with other entities). Let the reader recall that everything which is or happens must in some manner involve some entity or entities. There are no such things as "pure" qualities, "pure" relationships, or "pure" creation, apart from the entities that exhibit, relate, and create.

Any Creator of other entities would thus need to exist and be a *part* of the universe, and it would need to relate to other entities in some manner, as a human creator relates to the entity "brick", when he constructs the new entity "building". The Creator would not be able to *create the universe,* the latter being a contradiction in terms.

But, in most variants of the monotheistic religions, God is not defined as an entity. As a matter of fact, God is defined precisely as a non-entity, something which does not only lack any set qualities, but which *cannot possibly be understood or perceived by anyone anywhere in the universe*.

God clearly fails the third corollary of identity, which states that any entity must have some relationship to everything else that exists. God also fails the first and second tests, as it is not defined *what* qualities God has. If God created the universe, He cannot have any qualities whatsoever, because the universe encompasses every entity that exists and thus every entity that can have qualities.

There exist numerous other arguments to refute the existence of God and the contention that "God created the universe", and it is not the purpose of this treatise to delve into them here. Suffice it to say that there has been presented *one of many* logical refutations to theistic cosmology.

A Refutation of Big Bang Theory

Essay VII

A modern version of the "universe creation" fallacy is the Big Bang theory, originated by Georges Lemaître, a Belgian priest and astronomer who lived from 1894 to 1966 and who saw the Big Bang as a demonstration of how the divine creation of the universe *ex nihilo* might have occurred. The Big Bang theory proposes that, some 15 billion years ago, the universe was created by the burst of a "singularity," this burst subsequently giving rise to the entirety of existent matter. The more contemporary and nominally more secular version of the Big Bang theory has been propagated by the work of empiricist-positivist cosmologist Stephen Hawking. Hawking has stated that a divine origin of the universe is an unnecessary hypothesis, because the Big Bang did not require an intelligent creator to trigger it. This formulation, however much of an improvement it may constitute, does not annul the essential similarities between the position that a divine creator initiated existence *ex nihilo* and that a spontaneous burst initiated existence practically *ex nihilo.* Both of these hypotheses rely on *ex nihilo* creation: a logical impossibility.

There are logical errors in the very notion of a "singularity." As we shall later explore, these errors involve a confusion between the Euclidean mathematical model of a point and the fact that no such points exist in reality, as well as series of common misuses of the term "infinity". But the Big Bang theory's flaws extend beyond this. The following questions suffice to disprove its most fundamental contentions.

If *existence itself* was created by the burst of this singularity, then, did or did not the singularity itself, whatever it was, exist, too? If we answer that it did exist, it could not have created the universe, or all of existence. If we answer that it did not exist, then it also could not have created anything, because to create, it is necessary to first have *that which creates* – i.e., some entity that exists.

Assuming that a singularity was a single entity, which exploded to result in the Big Bang, what caused the explosion? Explosion, like any type of creation, is an action, and an action is a relationship of multiple entities that results in the alteration of said entities' qualities.

If only a single entity acts, this is so because this entity is composed of other, smaller, entities that relate amongst one another. If I had a tank of oxygen attached, I could conceivably breathe and move about in a full vacuum, but the only way this could take place is through interaction among the entities composing me: my arms, lungs, nerve tissues, brain, and their multiple levels of sub-components, among many others. My isolated actions are thus still relationships between multiple entities. If the singularity were the only entity that existed, and had no component parts that could interact amongst one another, it could not have exploded, nor could it have *acted in any way whatsoever*!

Here it is proper to briefly explicate the derivation of the above conclusion from the identity axiom and its corollaries. An entity is what it is. It is the sum of its qualities. These qualities cannot change without some entity that performs the act of changing them.

But if the entity is some single, monolithic, component-less, indivisible thing, such as the Big Bang theory's definition of a singularity, and it happens to have certain qualities at a given time (such as non-explosivity, for example), and no other entity exists to change these qualities, there is no way that these qualities can be changed! A thing is what it is, and cannot, especially if it lacks volition, *spontaneously decide* to become something else and assume a different totality of qualities.

If such a component-less entity as a singularity were left *entirely unto itself,* nothing could have influenced a change in its quality of non-explosivity, and it could not have exploded. Without any mechanism to induce an alteration in its qualities, it would have remained just what it was, a singularity.

Given the fact that, today, we do not have a mere singularity as the totality of what exists, this scenario evidently did not take place. *There was no such singularity, nor did it explode to create everything else*! The Big Bang theory is flawed at its core, as is any theory that attempts to describe the "creation of the universe," a contradiction in terms. There are further grievous errors

in Big Bang cosmology, as well as many of the contemporary empiricist-positivist hypotheses and models surrounding it, which we shall explore in greater depth in later sections of this work.

The Universe Cannot Be Destroyed

Essay VIII

The universe is existence. If the universe could be destroyed, then, someday, it would be possible for *existence not to exist*! Such an assertion stands in clear opposition to the irrefutable axiom of existence.

Let the reader recall from our discussion of the three fundamental axioms of existence, identity, and consciousness that the statement "Existence does not exist" is tantamount to saying, ""That which has the essential property of existing does not have the essential property of existing," or claiming that A does not equal A. (Note that the word "that" in the above phrase is not used to denote any *single* entity, but rather *every* entity that has the property of existing.)

It is conceivable that, following the passage of a large amount of time, no entity that currently exists will remain in existence. The currently existing entities will, in that case, be transformed into some other entities. An entity, unlike the universe, must have a beginning and can have an end.

But the new entities that come about, whatever they are, *will* exist, and *will* comprise the universe. To say that the universe can end at time X is to say that all the entities that exist at time X will simultaneously not exist at time X, which is a blatant contradiction in terms.

The fact that the universe cannot be destroyed can be used to refute, once again, a whole host of theistic and empiricist-positivist theories, but the most prominent of these is the Big Crunch theory, a companion to the Big Bang theory, which proposes that, someday, the universe should shrink back to form the singularity that gave it rise.

Along with the self-evident contradiction involved in claiming that the universe can ever end, the Big Crunch theory errs in treating the universe as an entity, and, moreover, as a single entity in perpetuity. At the formation of separate entities from a singularity (itself impossible, as we have seen in Essay VII), these entities continue to behave in some coordinated fashion, as if they comprised one entity with a central means of controlling and directing its actions.

But, as already stated, the universe is *not* an entity; it is only the totality of all the distinct entities that exist. That which is not an entity cannot act in any way, for only entities can act. Expansion and contraction are actions inseparable from the entities performing them. Thus, *not being an entity, the universe cannot expand or contract*. Individual entities can conceivably move closer to or farther away from one another, but there is no reason to posit that all entities would behave in the same way at the same time, or that they would somehow be centrally “directed” to behave in that same way as a result of being “part of the universe”.

We cannot speak of the universe as doing *or having* anything *qua universe.* Even so-called universal attributes, such as existence and identity, can be validly termed "universal" because they *individually* pertain to every entity. Existence is a quality that individual entities have; it is not the quality of some all-encompassing super-thing.

The Big Crunch theory, in its portrayal of the universe's collapse, may, in its milder incarnations, suggest that multiple entities (that comprise the present universe) will someday become a single homogeneous entity, a singularity, which will consequently comprise the entire universe.

However, a *homogeneous entity* is one that does not have parts that can function as entities themselves. Man, on the other hand, is a *heterogeneous entity*, as is even an atom composed of distinct protons, neutrons, and electrons. It is possible to aggregate multiple entities into one heterogeneous entity, but not into a homogeneous entity, such as a singularity.

The logic behind the impossibility of creating a homogeneous entity from multiple entities follows thus.

It is self-evident that the universe consists of many different entities with fundamentally different natures and qualities.

That which has been made as a combination of different entities must retain in itself some of the qualities and components contributed by the constituent entities in the making of the combined entity. These qualities could be mass or volume, for example, or they can be even more indicative of the original constituent entities, such as texture, or shape, or length. The components could be atoms, or protons, or large molecules, or even whole macroscopic stretches of an entity made from a given element, for instance.

Different entities have different qualities and different components, and will contribute different qualities and different components to the making of the aggregate entity.

Having different qualities and different components within an entity necessarily prevents that entity from being homogeneous (i.e. being made of no distinct, separable components).

It is *logically impossible* for multiple entities that currently exist or *could potentially exist* to combine into a homogeneous "singularity." It has already been demonstrated that a singularity could not have been the beginning of the universe, nor can it be the universe's end. Moreover, it will be shown in further discussions that such singularities *cannot exist altogether*.

The Requirements for Homogeneous Entities

Essay IX

Before we explore the properties of homogeneous entities, mention must be made of the fact that *man does not yet know of any homogeneous entity that really exists!* Even the smallest subatomic

particle currently perceptible is thought to possess distinct components that can be studied as entities in themselves. The qualifications for being a homogeneous entity are the following:

1) *Uniform distribution of every quality possessed*. For example, the density of a homogeneous entity must be uniform throughout.

2) *Impossibility of complete spatial separation*. Neither a homogeneous nor a heterogeneous entity can have its components separated by distances over which parts of the entity are not encountered.

Were a homogeneous entity thus separable, this would imply that the measurements of its qualities would *necessarily* not be uniform throughout. Thus, every component of a homogeneous entity must be spatially connected to every other component by stretches of distance that encompass the same homogeneous entity. (A more comprehensive discussion of space and distance will follow in subsequent essays.)

3) *Inability to act to alter itself.* A thing that is something cannot spontaneously become something else without undergoing definite physical transformations. These physical transformations entail nothing more than an alteration in a given entity's qualities. (Such qualities could change in their measurements or in the very fact of their applicability to the entity.)

But the only way an existing set of qualities can be affected is by some entity that has a somewhat different set of qualities from the original. An entity that affects its own qualities on the basis of those same qualities would be doing nothing; the qualities could only affect themselves by remaining precisely what they were originally. Thus, to be altered, a homogeneous entity would need some outside entity to interact with it.

It becomes evident from these qualifications that only Democritus's "atomos" entities, the postulated basic "building blocks" that comprise all more complex entities, could conceivably be homogeneous entities.

It is the task of physics and the specific-observational sciences to verify whether or not such indivisible basic building blocks exist, and what their specific set of qualities is. In the present, the existence of homogeneous entities is a mere hypothesis; cosmology cannot tell us *that* such entities do indeed exist, but it can inform us *what qualifications* must be met by an entity that could be termed homogeneous.

It is clear, however, that the entities ubiquitously experienced by human beings are heterogeneous. Indeed, every human individual is a heterogeneous entity. A heterogeneous entity need not exhibit uniform distribution of all of its qualities, and, because it has distinct component parts, it is able to act to alter itself. Like homogeneous entities, every heterogeneous entity must be spatially continuous in order to be legitimately classified as an entity. A thorough discussion of this requirement takes place in "Entities and Spatial Continuity" in the section of Related Essays within this volume.

The Impossibility of the Universe Having a Shape, Boundary, or Edge

Essay X

Recent empiricist-positivist speculations have entered the realm of whether or not the universe has a particular geometric shape, whether it is curved, or donut-shaped, or spherical, how far the "edge of the universe" lies, and what is "beyond" that "edge".

God, "parallel universes," and the possibility of "round-the-universe trips" have been invoked in empiricist-positivist theories attempting to explain these "riddles". However, there is nothing mysterious about questions such as "What shape is the universe?" or "What is beyond its edge?" These questions are simply *erroneous.*

"Shape" is a quality pertaining to an entity; it is a quality derived from a given entity's measurements in three spatial dimensions, such measurements being a topic for later discussion. "Boundary" is another quality derived from the quantitative extent of a given entity's measurements in three spatial dimensions. Wherever these measurements end is the entity's boundary.

These are qualities pertaining to entities, but the universe is not an entity. The universe is simply a convenient shorthand for "everything that exists", a verbal substitute for listing every specific entity by name. Thus, the universe cannot be cubic, rhombic, octahedral, cylindrical, spherical, or *of any other shape*. The universe is not a particular entity, and does not have any measurements pertaining to it *qua universe.* Lacking such measurements, it also lacks any "boundary" at which said measurements would terminate.

Indeed, to discuss the "shape" of the universe is akin to wondering what kind of "shape" the following *group* of entities has: (a specific table in Chicago, a specific chair in Bombay, a specific knife in London). Without moving these entities so that they touch one another, we can invent a term to call this group. We can refer to it as supertableknifechair. Would it make any sense to speak of supertableknifechair having a "shape" of any sort?

But the universe is just supertableknifechair *and everything else.* If supertableknifechair can have no shape, how can the addition of other entities to this group, irrespective of their location, impart a shape upon the result?

Let us also note that this does not imply that the universe is "infinite," either – i.e., that it has spatial measurements of infinite magnitude. “It” does not have *any* measurements whatsoever. Measurements pertain only to entities, and the universe is not an entity. The terms "finite" and "infinite" are of no relevance to the universe, as shall be shown in later essays.

Moreover, there is nothing beyond the universe. The universe is *defined* as *everything that exists.* There cannot be anything more! If we granted that there was something outside the universe, this entity, outside of what exists, *would not exist*, thus still affirming the fact that there is nothing beyond the universe.

Chapter III
Space

Why There is No Such Thing as Space

Essay XI

There is no such *thing* as "space." In order to be defined as an entity, space would need to meet the first ontological corollary, which states that an entity is the sum of its qualities. In order to pass this test, space must *have some qualities in the first place.*

But space lacks *any* qualities whatsoever. "Space" cannot be said to have mass or a finite volume. As previously proved, there is no finite boundary at which "space" officially ends, nor is there a finite shape that "the entirety of space" can be fit into.

Moreover, though separate stretches of what can be termed "space" are measurable (such as the distance between Entity A and Entity B), linear measurements in three dimensions cannot be attributed to the *totality* of space. As an example, it would be absurd to propose that the entirety of space is twelve billion kilometers long, three billion kilometers wide, and sixteen billion kilometers high.

We have affirmed that space is *not* an entity. But what can be logically meant by the referent "space"? There are in fact two referents concealed in one, each of which has a different purpose with which it is used. Here, they shall be termed *space-as-absence* and *space-as-relationship.*

Space-as-Absence

The term "space-as-absence" is synonymous with "void," "emptiness," and "nothing." "Space-as-absence" denotes merely *the non-presence of entities.* It is essential to note that space-as-absence is *not* an existent. As follows from the axiom of existence, *something is,* but *nothing is not.*

As the thinker Manfred Schieder demonstrates in his treatise, "Ayn Rand, I, and the Universe", it is not even possible to logically use the word "is" following a term such as "space-as-absence". Schieder describes two premises that are essential for an accurate description of the universe and of "space-as-absence".

> *1) "What is, is"*
>
> *2)*
>
> *After the enumeration of 2) a blank space has been left on purpose, to better convey the sense of the premise immediately resulting from the first one, which is: "What is not, is not". As said before, our language is so object-oriented that it cannot describe what is*

meant by the statement "What is not, is not" in any other way than by not saying it, since "what" already implies an object and "not" is the negation of either something existing or of negating the action of something existing.

Since "space-as-absence" does not exist, neither as an entity, nor as a quality, nor as a relationship, nor even as a totality of entities like the universe, it is fruitless to discuss it further. There is nothing more to be discovered about nothing!

But "space-as-absence" is not the only idea referred to when most people use the word "space." Another idea, best termed "space-as-relationship", is also implied in the same word. As such, the conventional English language's inability to separate the two terms engenders much confusion about what "space" means and thus triggers numerous philosophical errors which could be avoided with a clear distinction. Next, we shall explore the concept of "space-as-relationship," which differs noticeably from that of "space-as-absence."

Space-as-Relationship

Essay XII

The term "space-as-relationship" is synonymous with "distance" and "separation". In order to have any meaning, it cannot be a metaphysical primary. Rather, it must involve two or more distinct entities, or a single entity capable of motion and having its current position compared with respect to some earlier or later position.

It is self-evident (ubiquitously observable by all human sensory faculties) that not all distinct entities touch one another. There exist abundant examples of particular entities whose boundaries are not adjacent to the boundaries of other entities. No specific experiments are necessary to verify this claim, as evidence for it exists in the everyday experience of each human being.

As an illustration, the boundary of the entity "Pluto" does not contact the boundary of the entity "Big Ben". The entity "Taj-Mahal" also does not contact the boundary of the entity "Big Ben". Yet it is also self-evident that the entity "Taj-Mahal" would not need to alter its location to as substantial a degree as the entity "Pluto" would in order for its boundary to be immediately adjacent to that of the entity "Big Ben".

Thus, the *degree* to which the boundary of one entity can be separated from that of another can differ in magnitude. This variable separation is the reason for man's need to use the term "space-as-relationship".

Moreover, let us presume that the entity "dog" is running in such a manner as to alter its position over time. At time X, it will be farther from its starting location than it was at time (X-1). The dog at its starting time is separated from the dog at time (X-1), and even farther separated from the dog at time X. The magnitudes of these two separations also differ. Thus, it has been demonstrated that the use of space-as-relationship is also necessary when relating *an entity to*

that same entity at a different time, provided, of course, that this entity is capable of altering its position in any manner.

If a single homogeneous entity, like a singularity, were all that existed, however, "space-as-relationship" would be a useless concept, as this entity would not be capable of any motion whatsoever. (This was explained in our earlier discussion of homogeneous entities' inabilities to alter their qualities.)

The fact that "space-as-relationship" has its self-evident and demonstrable applications to describing the universe, and that it could never have come to describe a universe with only one homogeneous singularity, further verifies the impossibility of the universe being created by such a singularity.

The Ubiquitous Quality of Matter

Essay XIII

Space-as-relationship is not a single relationship. Rather, it is a threefold relationship, describable by three parameters, known as *dimensions.* This is primarily deduced not from the nature of the relationship "space", but from the natures of *all entities as such.*

Here we find the need to define several qualities which must be possessed, in some quantity, by *any* entity. We shall call these the **ubiquitous qualities of entities.**

Matter – Matter is otherwise known as the *constituent quality of entities.* Matter is simply *that, which entities are made of, and without which they cannot have any other qualities.*

It is not the province of ontology or cosmology to describe what the fundamental "building blocks of matter" (i.e., the entities that would represent Democritus's concept of "atomos") are. The specific-observational sciences must discover whether such fundamental building blocks exist, how many types of them there are, what they look like, and how they behave. Cosmology has only to point out that matter *exists,* and *exists as a quality of every entity.*

It may be asked here, "What, then, are such things as freedom, beauty, and peace, which are not in themselves composed of matter?" But these are not *things* as such! They are not entities, but rather *relationships* between entities that *are* composed of matter.

Freedom cannot exist without the individual who is free, and the individual is a material entity. Beauty, whether it be in a painting or a piece of music, cannot exist without the material canvas that holds the painting, nor without the instruments which emit the music. Peace cannot exist except among material individuals who decide not to relate to one another in a certain aggressive manner.

These are highly abstract and complex relationships, which, for the sake of word economy, humans often speak of as having certain "qualities" of their own. However, these qualities do not

pertain to the relationships *in themselves*, but rather to *every entity that undertakes these relationships.* It might be said, for example, "Freedom has the quality of the non-existence of military conscription." In the context of word economy, of course, this is an acceptable expression, provided that one knows what one is truly talking about. The words for which this intellectual shorthand stands are more numerous:

"The existence of individuals who partake in the relationship 'freedom' and who simultaneously partake in the relationship 'military conscription' is impossible."

The quality "matter" can be measured, and the measurement of matter is called *mass.* It is, of course, self-evident that one entity can have a greater or smaller mass than another. This mass can conceivably be of *any* non-zero finite magnitude, but must be of *some* non-zero finite magnitude.

The Ubiquitous Qualities of Volume, Length, Width, and Height

Essay XIV

Having previously discussed the ubiquitous quality of matter, which all entities must possess, we now proceed to consider other qualities which are universal to all entities: volume, length, width, and height.

Volume – Volume is an entity's expanse. Anything possessing the quality "matter" must have an expanse that corresponds in some proportion (though it could correspond in a variety of proportions) to the amount of the quality "matter" that the entity has.

That is, if the quality "matter" exists in an entity, it must have a real manifestation; this manifestation is volume. If the quality "matter" and the quality "volume" did not coexist and were not inextricably connected, we would encounter absurdities.

Volume without matter does not describe anything whatsoever. It would be just an arbitrarily picked region of space-as-absence, the latter being nothing whatsoever.

Matter without volume, too, describes what cannot exist. This would be tantamount to the quality "matter" existing *nowhere,* i.e., not existing, and the consequences would be the same: space-as-absence. It is self-evident that both qualities must be present, in some magnitude and combination, in every entity.

Linear Measurements: Length, Width, and Height –A *line*, in Euclidean geometry, denotes the shortest conceivable path which an entity would need to travel in order to reach any location from any other location.

The linear measurements of an entity are the measurements of those qualities which express the separation of various parts and boundaries of that entity with respect to the shortest conceivable path between them.

There are three independent linear measurements, which are *mutually perpendicular.* Any other linear measurement is in fact some combination (a vector sum) of any or all of these three mutually perpendicular linear qualities, which are known as length, width, and height (or, in the three-dimensional Cartesian coordinate system, as values along the x, y, and z-axes). Length, width, and height, as qualities, can also be termed *dimensions.*

It is important to note that these dimensions do not exist *independently,* but rather pertain to the entities that exhibit them. Each entity must have a certain maximum length, width, and height, though these measurements may vary in some relation to one another, i.e., depending on the particular region of the entity one examines.

For example, an entity may have a certain height somewhere along its length, and have its height increase or decrease farther along its length. In relation to one of the three dimensions, an entity can conceivably have *any* measurements in the other two dimensions, but must have *some* measurements.

As a primary, it is not space-as-relationship that is three-dimensional (as relationships cannot exhibit qualities *qua* relationships), but rather every single entity that exists or can conceivably exist. It has already been demonstrated that different entities can be separate in their boundaries, and the degree of this separation is precisely what space-as-relationship denotes.

Because, moreover, all entities exhibit the three dimensions as qualities, their separation can only be expressed as a combination of three measurement parameters. After all, one entity can be separated from another by a distance A in the X direction, as well as by the same distance in either the Y or the Z direction. In each of these three cases, the relationships are not the same, and were there four entities thus positioned (including the original entity and the three entities separate from it), each would occupy a distinct position and would be separated from every other.

Coordinate Systems

Essay XV

To render it simpler to relate any one of the multitude of entities in existence to any other among such entities, it is possible to devise a *coordinate system* based on three numerical parameters which measure each of the three qualities known as dimensions.

The measurement interval deemed a *unit* in the coordinate system must necessarily be an arbitrary product of human decision, since no such *thing* as space exists, and thus no absolute markers on it are provided to determine what the one true unit must be.

However, this arbitrarily selected interval must *uniformly* denote a unit *in all instances* in which this coordinate system is used. It is impermissible to have a given interval declared the stretch from position 0 to position 1, and then have position 2 pronounced to be thrice as far from position 0 as position 1.

Moreover, the coordinate system must assume an arbitrary starting point, or *origin,* in which each of the three dimensional parameters has value zero. This point could be located on an entity or outside it, however human convenience may suggest, so long as due caution is exercised *not to mistake such a point, or any point, for an entity in itself.*

Every point on the coordinate system, including the origin, is merely a part of a mental model used by man to interpret the real relationships among entities in three dimensions.

The necessity of points is evidenced by the fact that *it is conceivable for any entity to assume any degree of proximity or distance with respect to any other entity*. It is possible for the entity "dog" to be separated from the bouncing entity "ball" by distances of (2,3,4) units in each dimension. The dog then endeavors to approach the ball and bounce it upward against its head, somewhere in the process achieving a separation of (0,0,10) units from the ball. It is also conceivable for a spaceship to then pick up this ball and carry it far beyond the dog's access, reaching a separation of (10^{50}, 10^{53}, 20^{40}) units between dog and ball.

Any combination of finite, rational numbers, however large or small, can express the degree of separation between real entities, and thus must be available via an accurate model of said separation. Thus, the idea of a "point," some hypothetical position denoting a particular degree of separation from some other such hypothetical position, becomes necessary.

This does not, however, mean that the point is an actual existent, nor that the point can contain, in itself, an entire entity. Entities must, by the very fact of their existence, have some measurements in all three dimensions, and thus cannot be constrained to a single dimension, and, even more so, to a non-dimensional point. However, it may be proper to state that a given point may identify precisely with one of the positions along an entity's outermost boundary, i.e., describe the precise extent of an entity's measurements of either length, width, or height.

The impossibility of a point ever containing an entity is illustrated every time a mathematician seeks to represent a point on a piece of paper. It is impossible to draw a "point" on paper that does not have some measurement in each of the three dimensions. This "point" might be a millimeter long and a millimeter wide, and the graphite from the pencil used might extend to a height of a tenth of a millimeter, but some length, width, and height are inevitably possessed by the graphic representation of the point. Any such specific graphic representation could be considered an entity, but not the concept of the "point" which it is supposed to depict.

This is further proof of the impossibility of the existence of "singularities", a proposition upon which the Big Bang and Big Crunch theories rest. A singularity conceived of as a sole point containing mass, but mass without volume – i.e., a point-entity – is a contradiction in terms. We have already explored, via numerous perspectives, the truth that mass and volume must be mutually present in every conceivable entity.

The Euclidean Line

Essay XVI

The work of the ancient Greek mathematician Euclid has been perhaps the greatest leap in human history toward the understanding of real spatial relationships among entities.

The geometry that Euclid laid the foundation of (today known as Euclidean) functions splendidly as a model to study the dimensional qualities of entities, provided that it is always remembered that the tools used by the Euclidean model, as by all mathematics, are just aides for the human cognition, and do not represent things in themselves.

The sum total of Euclid's findings and derivations need not be explicated here, as they are easily accessible in any elementary treatise on mathematics, and their systematic elaboration is not the purpose of cosmology. Rather, cosmology seeks to discover in what manner Euclid's system is capable of representing reality using constructs, such as points, lines, and planes, which cannot possibly represent any real entities *qua* points, lines, and planes.

Since the subject of points has already been extensively covered in Essay XV: "Coordinate Systems", we move now to the matter of lines, or one-dimensional constructs.

Though no entity could have only a single dimension (as this would deny it the quality of volume), it must be recalled that each of the dimensions is a quality representable by a linear measurement, a line being the shortest distance between two distinct locations.

To measure dimensions in any other manner but linearly is absurd and standardless. When one admits measurements of arched dimensions, parabolic dimensions, zigzag dimensions, or dimensions twisted and curved in any manner one fancies, one is allowing one's whim, not any objective fact of reality, to decide the magnitude of a given separation. Moreover, one commits the contradiction of claiming as one dimension what inevitably requires *two* parameters to describe. Since A=A, and 1 does not equal 2, dimensions are linear.

To *isolate* a line and investigate whatever pertains to such a construct, as Euclidean geometry undertakes, is merely to examine *one of the qualities* possessed by entities and to study what this quality is and how it is made manifest. This does not render the qualities of length, or width, or height – which can be examined through a study of lines – independently existing, as all qualities can only exist as derived from the entities that exhibit them.

The Euclidean model focuses upon the study of qualities that pertain to entities, and can do so without necessarily analyzing the entire entities that have such qualities.

For example, it is possible, in reality, to encounter the necessity of determining *how wide* the separation between two boxes of identical shape and volume is. These two boxes are on a level floor, aligned with one another, and have no other parameters separating them except one.

It is quite permissible to use the model of a line – on which two points can be designated the extremities of one box, and two further points designated the extremities of the other – and thus compare the boxes' position with respect to the sole quality which differentiates them – separation in the dimension of width. All other qualities the boxes possess are simply irrelevant in the context of this study, but the Euclidean model can still perfectly represent the quality that we *do* wish to examine.

Once again, it must be remembered that the *mental isolation* of the quality in question that man's mind performs is in no manner akin to a *physical isolation* of such a quality, which remains firmly integrated into actual entities, and is inseparable from them.

Euclidean Planes and Three-Dimensional Constructs

Essay XVII

The Euclidean plane, a two-dimensional construct, enables the study of an even vaster and more complex interplay of qualities than does the Euclidean line. Euclidean three-dimensional constructs are capable of describing *all* of an entity's spatial qualities, though they still omit the quality of matter from the mental model of the entity.

The Plane

The plane is, in effect, a mental model isolating for study all the possible variations that can exist in the combination of any of two of the three linear dimensions. Two-dimensional shapes, curvatures, and patterns may be the results of such variations, which can be found as emergent qualities – qualities whose existence is based on a certain interplay of more basic qualities – in entities.

Circles, for example, are a quality possessed by the entity, "cylinder," which, being three-dimensional, can exist in reality. Each of the properties of shape and curve constructs on a Euclidean plane will hold if these shapes and curves are qualities of a given entity; the sum of the angles on the surfaces of a triangular prism will always measure 180 degrees, given that this prism possesses the quality "triangles".

A three-dimensional projectile will still follow a parabolic path in two of three dimensions (and will not alter its parameters in the third). A cylinder's rim will measure 2π times the radius of its surface. Thus, we see how the findings of a Euclidean investigation of the isolated interplay of two dimensions can be applied, with complete accuracy, to actual, three-dimensional entities.

Moreover, elementary and ubiquitously accessible empirical observation yields the conclusion that, although entities can never be purely two-dimensional, there is nothing barring the *surfaces* of entities from being such.

The entity "cube" for example, is three-dimensional, and, assuming that man possesses a technology precise enough to refine the faces of a real cube so that no ridges, creases, or

miscellaneous imperfections may remain on them, the resulting *perfectly smooth* surface would be two-dimensional.

No matter which point one picks on the side of the cube, it would have the same numerical coordinate in one certain dimension that does not vary on the two-dimensional surface. Rather, such a dimension would constitute the cube's *depth*, and the measurement of this dimension would be necessary in order to describe those regions of the cube which are beneath its surface.

Whether or not *ideal* two-dimensional surfaces have yet been observed in nature or obtained via man's technological precision is not the province of cosmology to judge. Cosmology only informs man that such surfaces are *conceivable* as existing in reality, as parts of real entities. Of course, not all surfaces are two-dimensional. Surfaces may be three-dimensional, as the surface of a sphere, cone, or any other entity with non-planar contours will demonstrate.

Euclidean Three-Dimensional Constructs

Moreover, whenever Euclidean geometry ventures to describe three-dimensional relationships and shapes, it begins to address the entire interplay of linear measurements necessary in comprising an entity.

Spheres, cubes, cylinders, and prisms, for example, are all conceivable as actual entities. Of course, in order to be such, they would also need to be composed of the quality "matter", which Euclidean geometry does not directly address.

Thus, three-dimensional geometry can express, with complete accuracy, the entirety of the linear measurements applicable to an entity, and study these qualities in isolation from the remainder of the entity's qualities, such as matter. Though it is immensely realistic, three-dimensional geometry, like all mathematics, remains a model, not an actual existent.

Chapter IV
Change and Time

The Existence of Change and the Necessity of Time

Essay XVIII

The three spatial dimensions suffice in describing the constituents of a universe that are, in their entirety, absolutely static, and have not even a *potentiality* of being altered in their qualities. A universe of entities exhibiting only mass, volume, length, width, and height would be a universe that subsumes only entities, qualities, and static relationships of position, which would remain constant in perpetuity and admit no effect of any entity upon any other.

Ubiquitous observation, however, informs us that, in the actual universe, such effects are made manifest unceasingly. The vast majority of actual relationships, the reader will recall, are interactions between two or more entities that affect some change in those entities' qualities.

We note that A=A, and a certain magnitude equals that magnitude, and no other. Then, how do we account for the fact that the same dog, for example, may have mass X, and, upon eating a dog treat, increase its mass to (X+1)? The fact that things are what they are cannot be denied or disproved. Thus, we must search for the answer within the framework of the axioms of existence and identity.

By the axiom of identity, it becomes self-evident that no entity can exhibit *simultaneously* different magnitudes of the same quality. Yet it is also self-evident, through ubiquitous observation, that a given entity *can and most often does* exhibit different magnitudes of the same quality. Thus, we are left to conclude that these magnitudes, to be mutually inclusive within an entity, must be *non-simultaneous.* To be non-simultaneous, they must be *separated in some manner.* This manner in which non-simultaneous measurements of the same quality in the same entity are separated is *change.*

The "separation" implied in the concept of change is not exclusively spatial, though, in almost every conceivable example, there is a spatial component to it. For example, a sphere to which another entity of some mass is added thereby also becomes more voluminous. Nevertheless, to describe the sphere's transformation in terms of the three spatial dimensions alone would be insufficient. One would be left with the contradiction of having a sphere of mass X and that same sphere of mass (X+1) occupying the same spatial position simultaneously!

These two states of the same sphere must be separated by *some other dimension,* a dimension that can be called *time.* It is separation through time, or temporal separation, that makes change possible and accounts for the ubiquitous observation of the same entities having different magnitudes of the same qualities.

The Nature of Time

Essay XIX

Any change is inevitably a relationship between some multiplicity of entities, since no homogeneous entity can affect a change in its own qualities, and the changes in the qualities of a heterogeneous entity can always be explained via the interactions of the entities that compose it (as a heterogeneous entity consists of smaller entities by definition).

Time is *that quality of an entity whose measurements increase as change occurs*. It should be noted that the change that must occur in order for the measurement of the quality "time" to increase is not the change of any particular entity, but *any change whatsoever*.

As a matter of fact, so long as the very *possibility* of change exists as an interaction between as few as two entities in the entire universe, the concept of time retains meaning, and *each* entity's particular measurement of the quality "time" must necessarily increase. This proposition will be examined in greater detail as the basis for a universal and uniform time scale.

Time can be called a quality of entities, because it can be exhibited by particular entities only. There is no such *thing* as time. Time is not a factor of some "cosmic fabric" separate from entities. Rather, just as each entity must have a spatial existence, so must it have a temporal existence that is measurable.

An entity's *age* since the first moment of its existence is the measurement of the quality "time" exhibited by that entity. An entity's age can only increase and never decrease, even if a given change that had occurred with respect to it has been undone precisely.

For example, an entity with shape A at age X could have its shape transformed to B at age (X+1), and then could return to shape A at age (X+2). This would not reduce the entity's age to X, however, because an entity that experiences a change, and then experiences an inverse change, does not *un-experience* either of the changes. There is no physical mechanism that can arise after the occurrence of an event and obliterate the very fact of the prior occurrence.

The transformation from A to B happened, otherwise the transformation from B to A could not have nullified its effects. If the transformation from B to A were capable of *wiping out from history* the former transformation from A to B, then it would follow that, the original change not having existed, there could also not have been a change to reverse a non-existent change. Thus, the change assumed to "obliterate" a past event would thereby also obliterate itself and *not exist.*

From this is evident the impossibility of changing the course of a past event, since whatever would change the past would also need to not exist, and thus would not be able to change the past.

Time as a Dimension

Essay XX

Since it is impossible for any event to change the past, no entity can have the same age at a given instant in time as it did at some other temporal instant. Since the process of change is, by definition, one of change *taking place,* rather than *annihilating the fact that it had taken place,* the latter of which is impossible, any measurement pertaining to change must be positive.

Since the sum total of all changes (including mutually antagonistic changes) that have ever occurred can only accumulate, it follows that time – the quality of entities that renders change possible – must, too, possess positive increments and constantly accumulate in its magnitude within every entity.

Though the three spatial dimensions have the ability to increase *or* decrease in their magnitude within any given entity, the fourth dimension, time, can only increase in its magnitude.

The reason why time is, too, a dimension, though not a spatial one, is the impossibility of relating any two real entities without describing some involvement of the quality "time".

Even if we consider two spheres frozen at some set distance apart, we must still make mention of the fact that the two spheres are in such a position *simultaneously,* recognizing that the spheres' relationship was not merely a part of each sphere's bygone history, nor is it only possible as the spheres accumulate age (i.e., in the future).

We merely admit that there is some dimension (time) which is mentally held constant for the purposes of the present examination, as we are only observing the relationship of the spheres in one particular moment, as we had, in Essay XVI: "The Euclidean Line", observed the relationship of real, three-dimensional boxes in only one dimension.

Were such spheres to exist, *there would be no way to hold the fourth dimension constant except as a mental model!* The three-dimensional boxes did not become one-dimensional simply because *man* used a Euclidean one-dimensional line to accurately express their relative position in terms of only the dimension "width".

Likewise, spheres with an existence in three spatial dimensions and one temporal dimension do not cease existing in the temporal dimension merely because the factor of time is beyond the scope of somebody's present observation of the spheres. In the real world, while man performs an analysis of what the spheres' spatial relationship was when the spheres each had some given age, the spheres' age continues to increase, *uniformly,* as the very investigation is conducted!

The Necessity and Nature of a Time Scale

Essay XXI

In Essay XV: "Coordinate Systems", the necessity of a universal coordinate system for relating the positions of all entities to the positions of all other entities was made explicit. This coordinate system's applicability was derived from the fact that entities can (and most often do) have varying degrees of spatial separation based on three mutually independent parameters.

It can similarly be claimed, through logic and ubiquitous observation, that entities can (and most often do) have varying degrees of temporal separation based on *one* parameter.

For example, the temporal separation between George Washington and G. Stolyarov II is of a lesser degree than that between Julius Caesar and G. Stolyarov II. Two entities need not be temporally separate, and it is conceivable (though improbable) that a given entity's span of existence may match perfectly that of another entity. As a matter of fact, in order to be distinct, two entities need only differ along *one* spatial dimension, as the example given in Essay XVI: "The Euclidean Line" of a possible linear relationship between two distinct boxes demonstrates.

However, the fact that *some* entities *are* temporally separate necessitates the existence of a scale to relate their magnitudes of separation. Just as a spatial coordinate system can relate all entities that presently exist using three dimensions, a time scale can relate all entities that *ever* existed using one dimension.

It must be recalled here that the measurement of time can only increase, and each entity may only have one age at any given instant. This implies that time is indeed a single dimension rather than a multiplicity of them, and can only be measured in terms of one parameter, thus necessitating a *linear* time scale.

This instantly refutes the common error of certain thought systems, such as Hinduism and Buddhism, which had proposed time to follow a cyclical progression. A cyclical progression, however, implies that the time scale would be circular, not linear, and a circle (or an ellipse, or any other closed curved shape on a planar surface) can only be depicted in terms of *two* dimensions. Since time is expressible only by one parameter, and since 1 does not equal 2, the time scale can only be depicted linearly.

Time as an Absolute Quality

Essay XXII

A spatial coordinate system, in order to accurately depict the positional relationships among all entities and take into account their varying degrees of separation, must exhibit uniform units. Any scale that is designed to represent inter-entity relationships must similarly be absolutely uniform, even though the span designated a unit on the scale is selected arbitrarily.

We have previously seen that a time scale, to have any purpose or meaning, must *by definition* be uniform. A year is a year is a year, no matter what happens to any particular entity during that year.

Therefore, though time is a ubiquitous quality of particular entities, it is not a quality that depends on the fluctuations of other such ubiquitous qualities. The measurement of the quality "time" within an entity – i.e., that entity's age – continues to increase so long as the entity has *some* measure of the other ubiquitous qualities.

That is, just so long as a given entity has *some* quantity of mass, volume, and the three spatial dimensions, it will exhibit the quality "time". But the *degree* to which it exhibits time, its age, does *not* vary in accordance with the quantitative fluctuations of *any* other qualities, even ubiquitous ones, the entity has. Each existing entity accumulates age in the same manner and at the same rate (rate itself being a function of time). This insight can be concisely phrased for future word economy: time is an *absolute* quality.

Let us assume, for a moment, that the contrary notion, that of *relative time,* were to be employed. By relative time, we shall describe the idea that the accumulation of the quality "time" varies from entity to entity.

The form of the scenario on which the theory of relative time inherently relies can be expressed thus: We begin our observation of entity A and entity B simultaneously. During the period of observation, while entity A has accumulated X units of time, it is possible for entity B to have accumulated Y units of time, where Y does not equal X.

The perceptive reader will note that the above statement is a contradiction in terms. The phrase, "During the period of observation..." begs the question: "A period, based on what?" The self-evident answer is that the period of observation is a certain *period of time.* Without the concept of time, the concept of "period" would have no significance; a period is a certain *span* of time for which there is reason to perceive it as noteworthy.

Thus, the scenario on which all notions of "relative time" are based essentially states, "During the same period of time, entity A can accumulate more/less time than entity B." This means that at least one of these entities would need to accumulate more/less time than it actually accumulates! Whenever one exposes a proposition as blatantly implying that A does not equal A, one knows that one has identified a fundamental logical error.

Conceptual Flaws in the Theory of Relativity

Essay XXIII

The uniform, absolute nature of time, demonstrated in Essay XXII: "Time as an Absolute Quality", implies a fundamental logical error at the core of the very foundation of post-Classical physics – namely, Einsteinian Relativity, which holds that the accumulation of time depends on the location and state of the observer.

A rejection of the *conceptual* core of Relativity does not, however, automatically imply a rejection of what valid observations Albert Einstein's scientific framework may have implied, or his theory's ability to predict certain phenomena when used strictly as an applied tool, without assumed philosophical implications.

One such (hypothetical) observation may be that astronauts in a spaceship that flies at extremely high speeds are not susceptible to the processes of bodily decay in as small an amount of time as those individuals who remain on Earth.

It may also be true that these astronauts' organisms' capacity to react to their environment (and perceive their environment) during a longer period of time will be roughly equal to the Earth-dwellers' reaction and perception capacities during a shorter period of time.

In other words, the *individual alterations of non-temporal qualities* of particular entities may conceivably be in accord with Einstein's propositions, as is the task of experimental physics to verify. But giving Einstein credit here does not excuse the error at the core of his theory – namely, the proposition that *time itself* is somehow relative to the observer.

Neither the degree of a man's senescence nor the level of activity with which his brain responds to the environment around him is *inherently bound* to the passage of *particular* time intervals.

The above two processes are relationships and thus, in order to occur, must occur within *some* amount of time, but there is no universal restriction that states that a man born in 1980 will have gray hair, wrinkles, and poor vision in 2060. That is, the opposite scenario is *conceivable,* even if it is not encountered due to the peculiar technological deficiencies of our era.

Being eighty years old does not necessarily mean being senescent, and a thirty-year-old astronaut sent at speeds close to $2.998*10^8$ meters per second into space in 2010 will not return in 2060 being thirty years old; he will be eighty years old, though his bodily form will be more typically encountered among thirty-year-olds than eighty-year-olds.

Though his *biological functions* will be less impaired by the passage of time than those of Earth-dwellers, the astronaut will still have accumulated the same *age* between 2010 and 2060 as someone who had remained on Earth during that time. To oppose this fact is to espouse the logical error of "relative time", which is not even *necessary* to support the possibility of the validity of some of the empirical implications of Einstein's theory.

Because I have explained the scenario of the astronaut's presence at speeds close to $2.998*10^8$ meters per second (the "speed of light" in the language of Einsteinian Relativity) without referring to the "relativity" of time, it follows that, by Occam's Razor, the concept of relative time is superfluous to Einstein's model, at least in this scenario. Einstein would have performed marvelously and yielded insights of remarkable accuracy if he, in the capacity of a physicist, had stayed within the bounds of physics, a specific-observational science, and not ventured to make generalizations which properly pertain to cosmology, a field of metaphysics and the rightful province of *philosophy*.

The Distinction Between Age and Senescence

Essay XXIV

The popular use of the words "old" and "age" may have, thus far, impeded some readers' understanding of the ideas in these essays. Thus, it is fitting to dispel certain undue equivocations employed in mainstream culture regarding these terms.

Let the reader recall that philosophy rightfully belongs to the realm of science, though it is a foundational rather than a specific-observational science. Thus, the terms employed within a philosophical treatise must each refer to one concept and one concept only, making distinctions between different cultural uses of the same word and correcting them by giving one of the uses a different name.

"Age" and "aging" are often used in the mainstream culture to refer to *senescence,* or the progressive decay of bodily mechanisms. The same words can also be used in the manner hitherto employed in these essays, to describe the measurement of the quality "time" accumulated by an entity.

However, aging and senescence are in fact two distinct phenomena that happen to correlate in human beings, some of whose internal functions deteriorate over time. One of these is purely an issue of the accumulation of *numerical age,* the other – a deleterious alteration in some of the physical qualities of cells, organs, and tissues.

The mainstream culture has committed the error of considering the two phenomena one and the same, and becoming "old" has become synonymous with becoming feeble and incapacitated.

A real consequence of this is a widespread perception in the contemporary culture that senescence is a necessary part of the natural order, and cannot be cured or reversed. According to this mindset, it is inconceivable for an eighty-year-old to have the robustness and vitality of a physically sound adult, and the very idea of a future procurement of indefinite longevity is scarcely allowed by this confusion of terminology.

Just as the conceptual errors of contemporary empiricist-positivist science ultimately reduce to the crippling notion that "we can never fully understand the secrets of the universe," so does this

conflation of terms ultimately reduce to the paralyzing superstition that man must somehow be permanently enslaved by the forces of death and decay.

Moreover, the false equation of the terms "numerically old" and "senescent" has rendered Einstein's idea of the "relativity of time" attractive in the general culture, as, according to this confusion, a physically robust astronaut who has traveled at near-light-speeds for 50 years cannot possibly be considered "old"!

Rather than recognizing every particular *entity* as accumulating age uniformly, as happens in reality, the relativists either render the concept of time meaningless by treating the spans defined by its units as entirely open to fluctuation, or elevate time to the status of some mystical entity-in-itself, which is what *must* have changed if human qualities did not behave as predicted during some interval of it.

The latter is tantamount to a senescing man claiming that, because he had shrunk in height over the past years, all of space is relative, and it was in fact the entity "space" which had grown!

Entities may change in their qualities, but units of measurement must ever remain uniform, if qualities and changes therein can ever be gauged in any meaningful manner.

Why Time Cannot Have a Beginning or End

Essay XXV

It is impossible for time to have either a beginning or an end. This follows from the fact that time is not an entity. Whereas each entity must have a temporal origin in order to, at any given instant, exhibit a finite measurement of the quality "time", it is senseless to speak of the temporal origin of any "pure quality", for qualities cannot exist apart from the entities that exhibit them.

The only legitimate statement that can be made regarding the "origin of a quality" in fact pertains to the origin of the first *entity* exhibiting such a quality. In loose terms, it may be fitting to refer to a certain "chronological origin of life", since life is an emergent quality built upon a variety of more rudimentary qualities and relationships, and the entities exhibiting these qualities and relationships first combined to bring about the emergent quality "life" some 3.1 billion years ago.

Any quality that derives itself from some more basic qualities and relationships (always, in each instance, provided by the entities directly exhibiting them), *could* have a temporal origin, though it is not known whether *every* emergent quality has such an origin. For example, the question of whether or not any historical entity exhibiting the color red was the first entity to do so has not yet been resolved.

But *ubiquitous* qualities, such as mass, volume, the spatial dimensions, and time, cannot have had any beginning, for all entities must exhibit them, and no entity can lay claim to the distinction of having been the first to do so.

The universe is the totality of all entities that exist. Since, as we have proved in two prior essays, the universe can have neither a beginning nor an end, it must be that the universe has *always existed.* By this, we mean that a totality of entities has always existed, but such a totality cannot exist without the existence of *some* entities, the entities which happen to compose it.

Thus, the eternal existence of the universe in effect implies that, at any moment to which one chooses to refer on a time scale, *some entities could be found that existed during that moment.* These entities were not necessarily the same entities that exist today, or will exist at some moment in the future. Nevertheless, it was the interaction of past entities that gave rise to present entities, and it is the interaction of present entities that will give rise to future entities.

Since every entity must have the quality of time, and entities have existed, exist, and will exist at every conceivable moment, it follows that time can have neither a beginning nor an end.

The Impossibility of First and Last Entities

Essay XXVI

There never was nor can there ever be a moment at which no entities exist. It follows that entities have always existed and will always exist – though entities that exist at one time need not be the same entities as those that exist at another time.

Entities cannot arise in any other manner except through some relationships among other entities. To claim anything else would be either to concede that there are such things as "pure qualities" outside of entities that give rise to entities, or to hold that entities could originate spontaneously, *ex nihilo.*

The former notion has already been refuted in prior essays. The latter notion claims, at its root, that A does not equal A. Such a scenario would propose that, at one instant, an entity has zero measurements of every quality – i.e., that the entity does not exist – then, at the next instant, some of its qualities suddenly have measurements of nonzero magnitudes.

Where did they get these increased magnitudes of qualities? Why, nowhere, of course! This leads to two possibilities, the first being that 0 does not equal 0, since zero would equal a series of nonzero numbers which represent the measurements of the qualities of the spontaneously generated entity, for, if that entity did not get those quantities from any other entity, it must have gotten them from itself, i.e., *always had them.* This is, of course, an outright concession of logical error.

The second possible implication of the theory of spontaneous generation is that the entity actually *did* get the new nonzero quantities of its qualities from *nowhere,* i.e., did not get them. Under this implication, the entity that did not get *any* qualities *cannot possibly exist*! To speak of an entity without qualities is in violation of the first ontological corollary, which states that an entity is the *sum* of its qualities.

We have thus proved that all entities are originated by other entities, that the universe always contained some sorts of entities, and that all entities have certain ubiquitous qualities, including time. This clearly implies that the quality "time" cannot have an origin, because no entity could ever conceivably be called the *first* entity with that quality. Moreover, these insights imply that no entity could ever conceivably be called the *first entity* to exist.

By similar logic, because the universe cannot have an end, neither can there ever be an end to entities altogether, nor any entity that could be deemed the "last entity in existence". Because time is a ubiquitous quality of entities, it will follow that there will *always* exist entities that exhibit the quality of time. Thus, time can never end.

When devising a mathematical model for our proposed time scale, we then can firmly assert that such a scale will assume the form of a Euclidean *line* – that is, a one-dimensional tool with an unending expanse in both directions. Individual entities can only "move" in one direction on that scale – the direction of increasing magnitude.

However, we are able to *mentally compare* entities that lie in either direction on the scale. This is integral to the human understanding of entities, their histories, and their possible futures, but this understanding cannot alter the constant, uniform, and unceasing accumulation of the quality "time" within every entity.

The Impossibility of a Universe Without Time

Essay XXVII

It has already been demonstrated that, whenever the magnitude of some quality of some entity is altered, explaining such changes in the absence of a time scale is impossible. However, it shall also be shown here that, even were all the entities in the universe to enter a period of absolute stasis, they would continue to accumulate the quality "time" uniformly, and their relation via a time scale would remain inescapably necessary.

Let us presume that two entities, A and B, enter absolute stasis (say, by coming to exhibit an absolute zero temperature by some means) simultaneously. Even now we see the need to relate them by a time scale, since we would observe a far different phenomenon had A and B *not* become static simultaneously – that is, had A experienced changes in its qualities while B experienced none, or vice versa.

However, one might ask, would one need a time scale to relate A and B *after* the instant at which they had become static? After all, their qualities would not change by definition after said instant. Yet, we know from simple observation of the phenomena around us, that stasis is not the only condition accessible to an entity. As a matter of fact, we have yet to observe a truly static entity in every respect.

Thus, we may assert knowledge of the fact that A and B *do not have to remain* static once they become static; some set of future circumstances is possible that would render them dynamic entities (i.e., entities with some changing qualities).

However, if this possibility exists, it also implies that A and B can become dynamic simultaneously, or at varying times, with A remaining static while B resumes a changing mode, or vice versa.

Even from the nature of the above statement, it is evident that an investigation into which of these conditions takes place can only be performed with the aid of a uniform time scale.

If A remains static for X units of time, while B remains static for (X+1) units of time, only a time scale can account for the difference of 1 unit, and only a uniform time scale can ensure that our tools used to relate the behavior of real entities do not equate X units with (X+1) of the same units, nor with π of the same units, for that matter, nor with any arbitrary number of units to which a relativistic time scale inherently renders one susceptible.

If the above reasoning is true of any two entities, A and B, it – if extended to a larger number of entities, or, indeed, to the totality of the entities which are the universe – must remain true, for a larger multitude of entities will still have the potentiality of entering or leaving stasis simultaneously, or at variance with one another.

It is theoretically feasible (though practically never observed) for no thing to experience any change in its qualities for some period of time, but it will matter for an accurate explanation of that phenomenon whether the stasis lasts a second, a year, or a trillion years.

It is true that, *during* that period of stasis, no observer would be able to make such a measurement, since an observer is also part of the universe and would, consequently, also be static in such a case. However, humans have often had need to refer to time periods which they had never personally experienced, from the time of the formation of the solar system, to the era of the dinosaurs, to the history of prior generations.

The human mind, as a potentially accurate judge of reality, possesses the ability to accurately relate measurements of the quality "time" in entities, no matter how far removed these measurements may be from the mind's *own* accumulation of the quality "time" – i.e., the duration of its individual existence.

The Independence of a Uniform Time Scale from Physical Phenomena

Essay XXVIII

Some will object to the claim of time's absolutism and uniformity by stating that our very ability to have a time scale depends on the dynamic nature of certain specific entities, our days owing their existence to the rotation of the Earth, our years – to its revolution around the Sun, our months – to the cycles of the Moon.

These thinkers would argue that, were the aforementioned entities to enter a period of stasis, our entire time scale would collapse, since they could no longer be used as reference points. Such an argument, however, is flawed in a multitude of ways.

First, it is fitting to note that certain of our units on a time scale have absolutely no relevance to the behavior of external entities. No celestial cycle occurs during a period of precisely seven days, for example, yet we maintain the keeping of weeks as essential units around which our time scale is organized.

No external phenomenon necessitates a week to be seven days. A ten-day week was, for example, tried during the French Revolution. No external phenomenon requires a day to be split into twenty-four hours, or an hour into sixty minutes, or a minute into sixty seconds – all inventions of the ancient Babylonians. These are arbitrary divisions, and – excepting a given individual's familiarity with and thus preference of one system over another – the accuracy of an individual's analysis of the temporal behavior of entities would not differ had the divisions been undertaken differently.

My claim is not meant to critique the *correspondence* of a time scale with physical phenomena, which may be useful for anticipating cyclical weather trends or coordinating one's daily plans with the availability of sunlight. However, *correspondence* and *dependence* are two different relationships entirely.

Were the Earth's period of rotation about the Sun to increase by a second, for example, "altering" the length of the year to fit this change would be absurd, as, it would imply that, in reference to our time scale, the Earth's period would not have changed at all, since it would still, via this adjustment, take a year for the Earth to orbit the Sun!

This would imply an overt evasion of recognizing that an actual event that had taken place. It is not reality that must be adjusted to our systems, but rather our systems adjusted to reality. If the Earth's period about the Sun did, in reality, increase, our system would need to accommodate the fact that the period would now be a year and one second rather than merely a year.

The Proportionality Requirement for Time Scales

Essay XXIX

We have previously shown that a genuinely uniform time scale does not depend on the motions of any physical entities, including celestial bodies. For example, if the Earth began to take one second longer to rotate about the Sun than it did previously, this would not give us license to "redefine" the year as having one additional second.

Of course, we would be at leisure to define a new interval on our time scale that would correspond to the new period of the Earth's rotation about the Sun, but, relative to a year, such an interval would always be one second longer.

It should be remembered that, to be an accurate measurement of real phenomena, a time scale can include units of any magnitude and any relationship of one unit's magnitude to another's. A day can be equivalent to 24 hours, or 86,400 seconds, or $3e^{-4}$ of some conceivable unit X of time that somebody might choose to invent for some purpose.

However, the requirement of uniformity on a time scale implies a *proportionality* of every given time unit to every other time unit. Two days, must, therefore, be equivalent to 48 hours, 172,800 seconds, or $6e^{-4}$ of unit X.

Similarly, so long as a time scale adheres to the requirement of uniformity, it does not matter which location on the time spectrum (which, again, is a part of a mental model, *not* any actual point on a real entity) is the time scale's "zero point", or the temporal arrangement of entities to which the scale relates all future configurations with a positive magnitude of a unit and all past configurations with a negative magnitude. The "zero point" may well be the traditionally posited birth of Jesus, or the founding of the French Republic, or the time at which George Washington signed the United States Constitution.

Nor is it necessary to have only a single "zero point" to which all other events are always related. For example, when I state that I wrote a poem "a day before yesterday", I am using yesterday, not the traditionally posited birth of Jesus, as the "zero point" of the time scale which I presently happen to be employing.

This time scale is perfectly consistent with the one describing the Common Era, as is evident by the faultless nature of the suggestion that I wrote the poem "a day before yesterday, on June 8, 2007" [I chose to retain the chronological reference I used at the time of the Second Edition's publication], since there exists a uniformity of and proportionality among all the units used – in this case, days and years.

As a matter of fact, whenever we introduce a multiplicity of different time units into our consideration, we employ a combination of different time scales by definition, with the scale of seconds having different intervals from the scale of days, which both have different intervals from the scale of millennia.

These scales need not rule each other out; they are different instruments at our disposal for different tasks. Much as a meter-stick would be useful for measuring one object's length, while the length of another could better be determined by a satellite electronically recording distances of hundreds of kilometers, so are different time scales suited for different purposes, but always within the same absolute reality, describing non-contradictory qualities involving real entities.

Since no particular physical phenomenon is inextricably necessary for the keeping of a time scale, it is possible for us to conceive a condition of hypothetical universal stasis in which a time scale could still be kept (by those who are awake and active afterward) and would be of necessity in describing the conditions pertaining to entities in such a state.

We would not be able to think about time scales *while in stasis ourselves*, since our thinking is in itself an act that involves the change in some qualities of some – indeed, many – entities. However, we presently can grasp soundly and with certainty that the quality "time" accumulates uniformly for all entities, in all conditions, in all environments.

Chapter V
Motion

The Nature of Motion

Essay XXX

Motion is the change in the three spatial dimensions facilitated by change in the one temporal dimension.

Having now an understanding of the four different qualities we know as dimensions, three spatial and one temporal, which entities must exhibit all four of and cannot conceivably exhibit any more than four of, we may proceed to describe a phenomenon which is a subcategory of the broader term "change" – namely, *motion.*

When we observe motion, what we truly perceive is the change of measurements of the three spatial dimensions pertaining to an entity. The entity's uniform accumulation of the quality "time" is, of course, what makes this change, like all other changes, possible.

We can *verify* the occurrence of the motion of a given entity when we note that its spatial separation from other entities has changed in some manner; that is, the threefold magnitude of the relationship "space" between that entity and certain other entities has been altered.

Such relations of multiple entities' past and present positions are sufficient to assert beyond doubt *that* motion has happened, but they do not in themselves define *what* motion is. This is so because entities' relative positions to one another can change due to a multitude of different events taking place.

A can move toward B until they are separated by X units, or B can move toward A until they are separated by X units. These two events are not one and the same, though defining motion solely in terms of relationships among different entities would conflate them. The sole means of avoiding this pitfall is to define motion *solely* in terms of the entity said to be moving, which would entail the use of an indispensable spatial coordinate system.

Due to uniformly accumulating measurements of the quality of time, it is possible to observe spatial separation in certain entities not only with respect to other entities, but also with respect to *themselves at past times.*

For example, we can state that, 24 hours ago, a ball's center was located at point A. Presently, it is located at point B, 50 meters away. By relating the ball's position when it has age X (in hours) at present to its position when it had age (X-24), we can claim with certainty that the ball's center has indeed moved a net distance of 50 meters during 24 hours.

By defining motion as a relationship between an entity's present and past configurations of qualities, it is possible to refer to motion on all surfaces, in all environments, and in contexts where all entities other than the one explicitly analyzed can behave in any of the entire range of conceivable ways.

Points A and B could be located beyond the Earth's orbit, in an ocean, on a ramp, or slightly above a floor, and, if one configuration of a ball's qualities entails its presence at point A, while another necessitates its presence at point B, the ball could be said to have moved from A to B.

A and B need not be entities themselves, however; they are merely reference points. This is where a coordinate system is necessary to identify them as such and to relate the entity's past and present states to each other, as well as to the spatial measurements of all the entities in the universe, by means of a set of uniform parameters.

Resolutions to Several Questions Regarding Motion

Essay XXXI

The question might arise as to how one might precisely define the location of departure for a given moving object (i.e., the location *from which* motion was initiated) and its location of arrival (i.e., the location *at which* motion ends).

That is, given two different sets of spatiotemporal coordinates for an object at point A and the same object at point B, how can one state that the object moved from A to B and not vice versa?

The answer to such an inquiry would be that, out of all configurations of spatiotemporal coordinates pertaining to a given event of motion, the configuration with the smallest measurement of the entity's quality "time" also pertains to the location of departure, while the configuration wherein the entity's age is greatest out of the set pertains to the location of arrival,

since arrival must take place after departure, and an object must accumulate age uniformly throughout the motion, as it would in stasis.

Furthermore, if we have two entities, X and Y, we can readily state whether X moved toward Y, Y moved toward X, or each of the entities moved some distance toward the other. If, on our coordinate system, X began at point A and remained at point A, then X must have remained in stasis. But if X began at point A and arrived at point B, then X must have moved from A to B. The same criteria would apply to Y or any other entity.

Thus far, we have spoken of an object's *net* displacement, i.e., the *ultimate* change in its spatial qualities as a result of motion *during a given time interval.* However, an object's motion from A to B in a straight line will be a different type of motion from motion in a zig-zag pattern or motion along a curve.

If the object moves continuously (which term we have yet to define), this will be a different motion from motion that is interrupted somewhere along the way by interludes of stasis.

The mathematical endeavors of Sir Isaac Newton have been able to produce a valid model for us to analyze the differences among these types of motion. Subsequent essays shall aim to demonstrate how the model of Newtonian calculus can be interpreted strictly in terms of the entities that exist and their actual qualities, so that this model might be used in coordination with the proper generalizations that its correctness presupposes.

Continuous and Intermittent Motion

Essay XXXII

Here, we shall address the distinction between continuous and discontinuous motion, as Newton's calculus provides the most direct investigation of the former of these.

If we were to define continuous motion, we would need to take into account the fact that, if continuous motion is the opposite of intermittent motion, it is motion not interrupted by periods of stasis between an entity's departure from and arrival at, respectively, the two points of reference selected by the observer.

If there are no periods of stasis involved in continuous motion, then, by extension, this must mean that, were we to select any number of particular combinations of spatiotemporal parameters pertaining to a continuously moving object, we would never see the correspondence of the same spatial parameters to different temporal parameters *unless* the object's motion entails passing through the same point several times – as would be characteristic of an object traveling in a loop, for example. In that case, if the number of times a continuously moving object passes through a given point C is n, we can never encounter more than n sets of the spatial coordinates of C plus some temporal coordinate, different for each set.

In contrast with continuous motion, were we to examine intermittent motion during which an object has stopped at point C, we could find *any number* of sets which each have the spatial coordinates of C plus some temporal coordinate, different for each set.

Let us assume, for example, that the object stops at C for a mere second, 4 seconds after it has initiated its motion. We shall also let (C_x, C_y, C_z) be the set of point C's spatial coordinates. Though the object lingers at C for only a finite amount of time, it is possible to take inexhaustibly many valid spatiotemporal coordinates for such a condition.

$(C_x, C_y, C_z, 4.1)$, $(C_x, C_y, C_z, 4.01)$, $(C_x, C_y, C_z, 4.001)$, and $(C_x, C_y, C_z, 4.0000000000001)$ are, among others, all correct spatiotemporal parameters describing the object during the static stage interrupting its motion from A to B.

Since it is possible to conceive of any number of decimals between any two integers, or any two rational numbers, and it is possible to create a time scale based on units of any conceivable magnitude, it follows that whenever an object is *not* involved in continuous motion, there is no exhausting the valid spatiotemporal parameters that might describe it.

However, it should also be added that motion which is intermittent using some two points of departure and arrival as points of reference will be continuous using, in this manner, some other two points of departure and arrival. For example, an object moving from A to B and stopping only once in the process at C can be said to move intermittently from A to B, but continuously from A to C and from C to B.

The phenomenon of intermittent motion is, therefore, nothing more than continuous motion interspersed with rest. During the process of intermittent motion, the time intervals over which the object actually moves cannot be characterized by anything but continuous motion.

Thus, continuous and intermittent motion are not truly contrary or mutually exclusive states. The latter designation is better attributed to continuous motion and rest, or spatial stasis.

Nevertheless, the phenomenon of "intermittent motion" is still one that needs to be described *within the context of the proper frame of reference.* If we are concerned about a car traveling from Chicago to New York, we will treat the situation differently if the car undertakes the ride without ever halting until it reaches New York than we will if the car makes a stop in Cleveland, or two stops in Cleveland and Philadelphia. *Some parameters* are different among these *entire experiences* of the car along its trip, and this difference is the number of times, if at all, that the car comes to rest. Another difference might be in the *length* of the time period during which the car remains at rest in each case.

In summation: *An object in continuous motion may be described as exhibiting* any *three particular spatial parameters only a limited number of times during its motion.*

An object at rest, be this rest a part of some phenomenon of intermittent motion or pertaining to an entirely spatially static object, may be described as exhibiting some *three particular spatial parameters an inexhaustible number of times during its state of rest.*

The Calculus as a Model for Continuous Motion

Essay XXXIII

The calculus is a mathematical system that enables one to distinguish between not only different *magnitudes* of continuous motion (i.e., some objects moving faster than others) but also the *temporal trends* that these magnitudes follow (i.e., acceleration and deceleration).

When one knows the equation modeling an entity's position as a function of time, differential calculus permits one to find a model for its velocity (first derivative) and acceleration (second derivative) as a function of time. If one knows any of the latter two, plus values for initial velocity and/or position of the entity in motion, integral calculus can assist one in creating an accurate model for the entity's position at any time at which it is moving.

The *mathematical* structures entailed in the calculus are well known and can be found in any comprehensive textbook on the subject. What shall concern this treatise in regard to the calculus is similar to what has concerned it in regard to Euclidean geometry.

Euclidean geometry, though in itself merely a model not *equivalent* to the entities it describes, is nevertheless capable of describing all entities' *spatial qualities* with complete accuracy. Thus, on the matter of the calculus, the subject of our investigation is the manner in which this mathematical model is capable of describing with complete accuracy the *motion* of entities while remaining a mere model not equivalent to said motion.

The derivative of a position equation, as a function of time, expresses an object's so-called "instantaneous velocity", or velocity at a given *point* in spatiotemporal coordinates.

We can, however, conclude that, if an entity is said to be in motion, it cannot be said to be in motion for only a single instant. That is, an entity's motion cannot occupy only one point in spatiotemporal coordinates, just as its position cannot occupy only one point in spatial coordinates.

Just as the Euclidean model of an entity's position necessitates that *any* real entity occupy an inexhaustible number of points (though some of these specific points can be said to lie on the entity's outermost boundary or its center of mass), so does Newtonian calculus necessitate that any entity in motion must be describable by an inexhaustible amount of *different* spatiotemporal parameters (though motion, as we have discussed previously, places limitations on how many times one can find the *same* sets of *spatial* coordinates in even a limitless array of parameters describing a moving entity's position).

Therefore, *no one* instantaneous velocity, nor any one instantaneous acceleration, nor any one n^{th} derivative of a position function, can *completely* describe an entity's motion. The question before us, then, is, can it *accurately* describe said motion within the limited point of view that such an approach necessarily entails? We shall answer this question as our exploration of motion unfolds.

The Role of Limits in Describing Motion

Essay XXXIV

When discussing the necessity of the point model in Euclidean geometry, I wrote that "*any combination of finite, rational numbers, however large or small, can express the degree of separation between real entities, and thus must be available via an accurate model of said separation.*" Correspondingly, within the realm of motion, any combination of finite, rational numbers, however large or small, can express the degree of *spatiotemporal* separation between two states of a moving entity.

The addition of the fourth coordinate, time, to this consideration, implies, in particular, the possibility of variation in the time separations between two of a moving entity's states. Thus, an entity could travel between two spatial points in one second, or in ten, or in 10^{44}.

But this variation is just as true for points that are separated by 1000 units of distance as it is for points that are separated by only 0.001 such units. No matter how small the interval of spatial separation between the two points used as a reference frame in the model becomes, it remains conceivable for an entity to arrive from one point to the other while its measure of the quality "time" increases by any of an inexhaustible range of quantities.

In Newtonian calculus, the derivative of a position function is obtained by means of taking a *limit.* That is, as we continue to indefinitely decrease our reference frame of an object's motion, and "narrow" this reference frame so that it continually *approaches* a given point (though it can never quite get there, since there is no sense in describing motion from a point to itself), what can we state about the entity's motion?

The derivative function for an entity's instantaneous velocity can always be used, in combination with our knowledge of the time of an entity's presence at the given point, to provide a numerical value for speed.

This value allows us to state *how an entity behaves as it moves through a given point at a given time,* yet, in itself, motion *through* a point implies motion *from* some other point and *to* some point still, and the same can be said about motion *at* a given instant in time.

Within the context of such an insight, an instantaneous velocity can only be interpreted as *the constant rate of motion that an entity would follow had it undergone its motion in precisely the manner in which it is known to have undergone motion through a given point at a given time.*

Velocities are always given in units of distance per units of time (meters per second, for example), and, an instantaneous velocity answers the question: if an object continued to travel just as it has traveled through a given point at a given time, how many meters would it traverse in a second? Other units may be used here where appropriate, depending on one's chosen time scale and coordinate system.

Instantaneous Velocities as a Means for Describing Motion

Essay XXXV

Precisely *what* an instantaneous velocity describes is no mere technicality – it is essential to our knowledge of what motion is and how to take account of it.

The human perception of time is analog: humans view time's accumulation as a continuous flow rather than a series of discrete instants. We are all the better for it, of course, because there is an inexhaustible number of temporal coordinates between any two points on a linear time scale, and, were we to perceive time in discrete quanta, it would take us an infinite amount of time to perceive *any* finite span of time, however small, which would result in an evident logical contradiction.

Because we cannot perceive any single instant of time, or what happens during it, we can only explain an entity's state during said instant by the model of Newtonian calculus, which *extrapolates* that behavior onto an analog interval of time – an interval that *is* accessible to human comprehension. This is the reason why the graph of a function's derivative at a given point is the straight line *tangent* to that point. The tangent line most often does not correspond with the graph of the motion itself, as rates of motion tend to change for most moving objects, but it allows us insight into what course the object follows at the point along the graph to which the tangent line is drawn.

In the real universe, fundamentally, entities are all that exist, for without entities there cannot be any other kind of existent. Entities have measurements in all four dimensional qualities. The human mode of perception, which absolutely and undeniably allows a correct apprehension of the external reality, indeed fathoms entities as having measurements in all four dimensions, and, in the case of time, accumulating age in a uniform, analog fashion.

The Euclidean model of geometry, however, further verifies the accuracy of the human ability to comprehend these properties by allowing, through the use of points, a description of *any part* of an entity's spatial position.

Similarly, Newtonian calculus reinforces the correctness of human perception of motion by allowing, by means of instantaneous velocities – and, by extension, accelerations, changes in acceleration, and even changes in those changes, so on indefinitely – the observation of any part of an entity's motion. Due to the discoveries of Euclid, no point comprising an entity need be unaccounted for, and, due to the ideas of Newton, no time interval during which an object moves need be left unexplained.

But it cannot be overemphasized that, however indispensable in mathematics and human cognition, points and instants are not real existents. Entities are real existents, and entities can never be confined to points, nor their behaviors to instants. Whatever special tools and techniques its analysis might require, reality remains, and shall always remain, analog and four-dimensional.

Differences in Paths of Motion

Essay XXXVI

Thus far our discussion has concerned itself with an explanation for motion trends' variation with time and the manner in which the model of calculus elucidates these. However, if these variations were the sole ones possible in motion, all of them could occur with respect to an entity moving along some *particular* path, such as a straight line.

However, it is ubiquitously observable that an object moving between some two points, A and B, can conceivably follow one among an indefinite variety of paths, be they curved, looped, bent, or any conceivable combination thereof.

Having merely the entity's points of arrival and departure as our reference frame, we cannot adequately describe its particular path. Thus, other considerations are necessary.

As with motion trends with respect to time, a narrowing of reference frame will result in a more accurate understanding of the entity's path, and, if the path between the chosen two points happens to be perfectly linear, the approximation mirrors reality precisely. In that case, net displacement, combined with an understanding of the object's velocity and changes therein, will suffice for a true description of its motion. However, if the path is not linear, it would be necessary to refer, again, to the model of Newtonian calculus.

Newtonian calculus may be applied as a model for the description of entities' precise paths in a similar manner to its ability to describe their rates of motion. However, instead of relating a coordinate of *spatial position* to a coordinate of *time*, calculus used in the description of paths relates a coordinate of *spatial position* to another coordinate of *spatial position.*

The relationships involved still compare measurements in one dimensional parameter to those in another. However, both dimensions involved (or all three of them, given a multivariable equation) are of necessity spatial, since any path but a line requires two or three dimensions to accurately describe it.

A derivative of a position equation entirely in spatial variable – again a constant when the precise spatial parameters of the point at which it is being analyzed are known and substituted into the expression for the derivative – gives the trend of an object's motion *through the given point in spatial coordinates* – i.e., the manner in which the object would have moved had the relationships of quantitative change among its spatial coordinates maintained throughout the entire motion the same nature as they possess when the object is moving through the given point.

Thus, no matter what point along an object's path one examines, one can state precisely *how* the entity is moving through that given point. It therefore follows that, via this model, no part of the entity's spatial motion need be left inexplicable.

Explanations of Special Circumstances Regarding Motion

Essay XXXVII

Once it is recognized that the Newtonian calculus can be used as a perfect model for objects' paths of motion, certain questions may still arise regarding special cases that are more difficult to resolve than the typical kind. But these, too, can be analyzed and fathomed using the methods we discussed earlier.

Even when the position equation of an object is one that never has a linear *equation* for a derivative (such as $y=e^x$, whose nth derivatives are all equal to e^x as well), the *particular* derivative (as well as the particular position coordinates of an object at a given point) will always have a numerical constant for a value, since x is presumed to be a known value of a point measured relative to the three-dimensional coordinate system we must necessarily use to accurately describe spatial qualities.

Moreover, the question may arise as to objects in motion along paths that combine in themselves a multiplicity of functions (such as a "v-shaped" or "absolute value graph" path) and could be said to have different derivatives for the same point, depending on the function in relation to which the derivative is taken (i.e., at a point of intersection between the two segments constituting a "v-shaped" path, one could conceivably take a derivative of either the positively or the negatively sloped segment).

Nevertheless, the presence of this multitude of possible derivatives need not be contradictory, provided that each it confined to its proper context. The derivative of the function describing the path *leading to the point of intersection* describes the object's motion *as it enters the point*, whereas the derivative of the function describing the path leading *away from the point of intersection* characterizes the object's motion *as it leaves the point.*

During the instant at which the object moves *through* the point, its path *changes* without its motion being halted. Since the human (and correct) mode of perception of spatiotemporal phenomena is analog, humans cannot *directly* grasp happenings encompassing an *instant* of time and a *point* in space (as these are zero-dimensional by all standards). Nevertheless, the human analog perception is capable of *encompassing* that instantaneous change and, via the model of calculus, *pinpointing* exactly where it occurs.

The presence of multiple possible derivatives at a point is a *sign* provided by the model of calculus that the given point is indeed a location for instantaneous change in paths of motion.

The Accuracy of Calculus in Describing Motion

Essay XXXVIII

We have hitherto discussed the ways in which the Newtonian calculus can enable us to understand objects in continuous motion, their velocities and changes therein, and the paths they follow. Furthermore, the calculus can even account for special circumstances regarding motion, as when none of the derivatives of an object's position function are linear or when an object's trajectory of motion changes as it moves continuously.

Finally, the all-pervasive question of this exploration may be put forth: if the model of calculus can describe a moving object's trends through spatial points and temporal instants, and human beings cannot by nature perceive points and instants, does the model of calculus nevertheless describe *precisely what humans perceive*?

The answer is *yes*, for, indeed, all the inexhaustible variety of potential paths and rates of motion that calculus might account for can be perceived by the human eyes *automatically*, and needs not take an infinite amount of time to be thus fathomed.

Indeed, the model of calculus employs points and instants to *narrow* the field of human investigation from what is normally perceived rather than broaden it, thus maintaining the phenomena thereby described entirely within the realm of perception, since the realm of perception is the broadest possible domain as pertains to motion.

That is, *there is no motion that the human senses cannot perceive given the proper reference frame* – considering, of course, that magnification technology may well be required to furnish such a reference frame. As for points and instants, they are not real existents (which are entities with analog measurements), but merely convenient tools employed by the model of calculus for keeping track of real existents to the level of precision desired.

Thus far, the empiricist-positivist advocates of the doctrine known as Relativity, which has dominated the physics of the 20^{th} century, have been shown to be utterly mistaken in postulating that there can be no absolute definition for motion, as this treatise has been able to not only formulate such a definition but also to explicate precisely the manner in which existing mathematical models are able to convey an accurate description of this motion, and verify that this motion occurs in precisely the manner in which it is perceptible by and accessible to the human senses.

Indeed, this integrated understanding of motion ought to reinvigorate our confidence in the validity of our sensory perceptions of the world and the efficacy with which we might use our observations to fathom, alter, and employ the entities in the universe to aid in our progress and flourishing.

Chapter VI
Waves

Waves as Ontological Relationships

Essay XXXIX

Current empiricist-positivist orthodoxy often sports the grave ontological error of claiming that "all entities are in some degree particles and in some degree waves." Of course, in order for this statement to hold any ethos, both the speaker's and the listener's idea of what a wave *is* must be quite vague indeed, and certainly not examined with any extent of philosophical rigor.

It shall be apparent from the present treatise that, while a particle is indeed an entity, a wave is a *relationship,* and an entity cannot be a relationship in itself, and, though waves are many times observed to *emanate* from particles, they cannot ever *be* particles in themselves, nor achieve an existence independent from the entities that happen to emit them and the entities through which they propagate.

The broadest definition of a wave, which applies to the tides of the ocean and electromagnetic vibrations alike, is that of a *periodic disturbance.* This immediately raises the question: a disturbance – of *what*? A disturbance is, by definition, an *action* of some sort. Since only entities can be acted upon, a wave must be a disturbance *of entities,* be those entities water molecules, air molecules, or coils of a spring when the spring is rotated to bring about the occurrence of sine-like curves along its length.

Moreover, since only entities can *act,* waves can only be produced *by* entities. *Waves are thus the actions of certain entities to invoke a periodic disturbance within other entities.* A loudspeaker may, for example, act to invoke a periodic disturbance in the air molecules of its vicinity, or a stream of air particles (known as "wind") may act to invoke a periodic disturbance in a large body of water molecules.

It may be recalled from Essay V: "What the Universe is and is Not" that a relationship is defined as "an interaction between or among several entities that affects, in some manner, the qualities of these entities." A wave is precisely such an interaction, requiring an entity to originate, and affecting the positional qualities of other entities so that said qualities vary with time in a periodic and cyclical pattern.

Thus, a wave is indeed a relationship. More specifically, it is a relationship of *certain entities inducing motion in others.* A vibration of any object implies some manner of positional displacement in that object, and a periodic vibration implies a *continuous and recurring pattern of displacement,* i.e., a mode of motion easily subject to description by the model of Newtonian calculus discussed in prior essays.

A Refutation of the Particle-Wave Duality of Entities

Essay XL

In the prior essay, we have shown that while particles are entities, waves are relationships among entities and thus cannot be the same as particles.

Hence, a "wave" is not some otherworldly substance coequal with a "particle" and necessarily *defining* all entities. Rather, at its core, a wave is merely one of the ways some entities can induce motion in others.

For example, the physical machinery within a loudspeaker might push the air molecules immediately in its vicinity in a certain direction, and those molecules might push those still farther off in slightly altered directions, and so forth, until this chain-series of pushes reaches its terminus upon the eardrum of the listener.

A wave is indeed an extremely intricate set of motions, as its periodic nature requires that specific entities orient themselves in precisely the proper directions to "push" the entities immediately adjacent to them. Nevertheless, the entities which originate the waves are observably capable of bringing about such complexity in their relationships with the entities thus "pushed".

Along with the complexity of wave relationships is apparent their *derived* nature from simpler and more fundamental concepts, such as those of material entities, relationships, space, time, and motion.

This insight should evidently exclude any notions that waves might be placed on an equal physical, metaphysical, *or* epistemological level to particles. Physically, they are *interactions among* particles (or, more generally, among entities). Metaphysically, they are *relationships among* entities. Epistemologically, an entire chain of concepts is required to derive the concept of a "wave," all of which themselves are established, through a lengthy logical sequence, from examination of entities and their properties.

Without entities, neither waves nor anything else can exist. Of course, as proved earlier, the complete cessation of the existence of entities is logically impossible.

Waves cannot exist without entities, but some entities can conceivably exist without waves – i.e., neither triggering nor partaking in such periodic disturbances. Indeed, if waves are just relationships of motion, it is entirely conceivable for an entity to be static during a given time period (i.e., experience no change in its three spatial parameters) or to undertake motion of a different sort, either non-periodic or not involving the astounding multiplicity of entities required to exhibit a wave relationship.

How many such entities exist in comparison with the entities that constantly partake in wave relationships is not cosmology's question to answer, but rather that of physics, yet cosmology can

state beyond doubt that the proposition that wave properties are somehow *inherent* to all entities is absurd.

Indeed, were a single entity placed in a vacuum and separated from the air molecules and other entities in its vicinity, it would *never* be able to exhibit wave relationships, as it would have no other entities to contact and induce periodic vibrations in! This would hold no matter how frequently or constantly the entity would exhibit wave relationships under normal circumstances, thus further verifying that waves can never be said to be *inextricably inherent* to entities.

Sound as an Objective Relationship

Essay XLI

Classical physics has confirmed that phenomenon known as "sound" is made accessible to the human perception by means of waves. This, while true, is an empirical observation and rightfully belongs to the specific-observational sciences.

However, even had sound not been made manifest by means of waves, rational cosmology's insights concerning this phenomenon would have nonetheless been the same ones as this treatise shall put forth. The core understanding of sound that cosmology presents – namely, that sound is a *relationship among entities* – must necessarily underlie all accurate specific-observational studies of this phenomenon.

The wave nature of sound phenomena aside, there is another, far more fundamental and incontrovertible manner in which the fact that sound is a relationship can be identified.

First, sound requires entities to *exhibit.* There can be no melody without the instrument or electronic device (disk player, MP3 player, computer, stereo system, etc.) that emits it.

Moreover, sound requires entities to *receive.* There can be no melody without the vibrations in the eardrums of the listener who hears it. Indeed, the waves that the emitting device will induce in the surrounding air molecules will continue to exist. However, absent an interaction with the auditory apparatuses of human listeners, the requirements for producing the pitches that men describe as "sound" have not been met, as the sound waves must cause the human eardrum to vibrate and thus stimulate nerve signals to be sent into the brain so that the brain might interpret them as a melody.

This does not mean that sound is relative, however. The objective natures of the human brain and eardrum, as well as the objective natures of the sound-emitting device and the waves it stimulates, cannot combine to produce anything but an *objective* relationship of sound. Two observers in an essentially same physical condition (i.e., without impairments to their hearing), present the same distance from an emitting device, will hear the same sound.

In the realm of cosmology, this insight reveals that sound is not in itself an entity, nor is it somehow distinct from the material realm. Some might claim that sound has no mass, no

volume, no dimensional measures associated with it, and thus that it is somehow distinct from all which is made of and pertains to matter.

This fallacy, however, rests on the presumption that sound is an independent "thing" made of some "otherworldly fabric". In reality, however, sound is emitted by material entities, and is in fact an intricate and mathematically precise relationship among millions of such entities which make physical contact with one another. Sound requires a material observer to receive, whose material eardrums would need to vibrate, entailing a material phenomenon spanning all three spatial dimensions and the one temporal dimension.

Chapter VII
Light

The Dangers of the Particle-Wave View of Light

Essay XLII

Almost no other concept has been more elusive, nor its misinterpretations more damaging, than light. Twentieth-century theoretical physics has built its most egregious fallacies on a series of errors with regard to this phenomenon.

Understanding the truth about light is nonetheless indispensable to one's ordinary existence, given that light is required to fathom anything visually. Furthermore, it is necessary for dispelling the ontological confusion that the "particle/wave duality" has brought about: a confusion that has led many to wrongly despair about living in an irrational, unfathomable, and worthless universe!

Such despair is groundless, yet it has wreaked enormous havoc in intellectual and popular circles. But all existential despair is a function of an improper view of what the world is. Thus, we shall endeavor here to provide a proper view as a remedy. Our first task is to confine physics to its legitimate scope.

While the specific-observational sciences can legitimately study the *particular* properties of light and the regularities with which it behaves, the *fundamental classification* of light belongs to philosophy and cosmology, as light is not only a ubiquitous observation, but, moreover, required for visual observation of all entities – a prerequisite for their full understanding. Thus, light can be said to be a *prerequisite to ubiquitous observation.*

Much of post-Classical physics has been directed toward the futile debate of whether or not light can be categorized as a "particle", a "wave", or some mixture of the two. This debate has led proponents of relativity and quantum mechanics to destroy the objective and valid meanings of the categorizations "particle" and "wave", in the attempt to fit them onto a phenomenon which they cannot describe – namely, light.

This turn of events is especially saddening, since the blind alley along which post-Classical physics has ventured was brought about by a question that is not even the province of physics to answer.

Physics has done immense services in studying phenomena of light reflection and refraction, as well as devising a system to quantifiably explain differences in types of light – the electromagnetic spectrum. However, when seeking to make metaphysical classifications, it has tried to substitute a few extremely narrow and targeted observations about light for the broader, universal definition thereof. This is a characteristic consequence of the empiricist-positivist fallacy.

Had its particular observations instead been founded upon and reinforced by the rigor of philosophical logic, contemporary physics would have avoided the pitfalls that caused it to reject the objectivity of the senses and of common sense.

Why Light is Neither Particle nor Wave

Essay XLIII

Our insights into cosmology thus far can quickly refute the devastating particle/wave duality of light.

1) Light is not a particle. A particle is an entity. It should be recalled that matter is one of the ubiquitous qualities of entities. Mass is the measurement of matter, yet light is massless. Light is not an element on the periodic table, nor is it a subatomic particle, such as an electron.

Light lacks mass, thereby lacking one of the ubiquitous qualities of entities, thereby not being an entity. Light also lacks all other ubiquitous qualities of entities, including volume and *any* measurement in any of the three dimensions. One could hardly say, "this beam of light is half a centimeter wide, twelve centimeters long and two centimeters tall." Thus, light thoroughly fails the test for being categorized as a particle.

2) Light is not a wave. A wave is a relationship of entities, a periodic disturbance of them. In order to travel from point A to point B, a wave has to encounter *continuous entities to periodically disturb*! Sound waves, for example, encounter such a continuity of entities in the form of air molecules.

However, in a vacuum, where no such continuity is present, neither is there sound. Light, on the other hand, *can* be made manifest through a vacuum, an observation requiring no highly specialized study. One needs only look out into the night sky and realize that one is seeing celestial objects separated from the Earth by billions of kilometers of the near-total vacuum which is space. Yet, somehow, light enables one to see them nonetheless!

The Sun is separated from the Earth by some 150 million kilometers of vacuum, yet its light is not only perceptible on Earth, but is the primary source of light here, and the precondition for all

life on this planet. Thus, vacuum is not only no impediment to light, but light must be quite adept at transcending vacuum in massive quantities.

The objection might be raised that outer space is not a complete vacuum, but that the occasional gas molecule does appear there. However, there is certainly not a *continuity* of *any* type or combination of particles beyond the reach of a given planet's atmosphere, and a wave relationship, in order to be exhibited, requires a continuity of particles that exert contact forces on one another. Two hydrogen molecules five hundred kilometers apart will not produce a wave relationship. Thus, in order to transcend a vacuum, light cannot be a wave, but rather must be *some other phenomenon.*

3) *Light cannot be* both *a particle and a wave.* We have just proved that light cannot be a particle and that light cannot be a wave, and that the synthesis of these facts will yield the logical conclusion that it cannot be any combination of two categorizations that do not apply to it. Furthermore, we recall from Essay XL: "A Refutation of the Particle-Wave Duality of Entities" that it is impossible for *any existent* to be simultaneously a particle and a wave, since a particle is an entity and a wave is a relationship – two different ontological categories that cannot be applied to the same existent.

It is essential to note that, simply because light shares certain *properties and behaviors* also attributable to particles and waves, does not mean that it *is* a particle and/or a wave. It is merely *similar* to particles in some respects and to waves in other respects, just as a dog might be similar to a cat in the fact that it has four limbs and to a camel in that it has an elongated snout. This does not imply that a dog can also be described as a cross between a cat and a camel!

Because it chose to discard philosophical considerations by the wayside, post-Classical physics has conflated similarity with identity. Additionally, it has employed the empiricist-positivist fallacy – holding that a series of narrow, targeted observations about light, in which particulate or wave properties were observed, therefore implies knowledge of the *fundamental identity* of light, which can only be known on the more basic and universal level of ubiquitous observation.

The Model of the Electromagnetic Spectrum

Essay XLIV

The electromagnetic spectrum has been often employed to quantify various types of light so as to relate them to one another in magnitude. The unit of measurement for said spectrum has been either a frequency or a wavelength, implying a preconceived notion on the part of the physicists designing the spectrum that light is a wave. Even though this designation has been shown to be incorrect, this does not mean that the quantitative *relationships* referred to on the spectrum are similarly incorrect.

If yellow light is said to have a wavelength of 580 nanometers and violet light – one of 400 nanometers, the true statement in that claim is that the ratio of units of magnitude of yellow light to violet light is 29 to 20.

The error made is simply in the *name* of the unit, since the *span* of each unit is selected arbitrarily, and the magnitude of violet light could well be selected to be 400 of a unit thus defined, with the stipulation, as always, that the units be uniform and that their proportionality reflect the actual proportionality of the magnitudes of the existents they describe.

A similar error might be conceivable if another confused society decided to conflate time with mass, and measure time in kilograms. Though the unit of measurement might be wrong, the *internal consistency* of the time-measuring system might in fact be accurate.

If a given period of time were said to have a unit of a kilogram, and a period of time twice as long – a unit of two kilograms, then the system can still give us an accurate tool for relating units of time to one another. It is only needed to substitute "second" or another appropriate name for "kilogram", and the system will work flawlessly.

The electromagnetic spectrum, furthermore, is a brilliant system for relating light to phenomena that would be measured on the same scale and by the same units (though not units of wavelength), including the commonly unexpected non-visible phenomena such as infrared, ultraviolet, X-ray, and (the misnamed) microwave radiation. It is a tool for real information about light, and the refutation of the theory that light is a wave will do nothing to nullify the spectrum's validity and usefulness; it could be preserved in entirety, even with present *magnitudes* intact, provided that the *name* of the unit using which light is measured is adjusted so as to reflect the unique nature of light, distinct from either particles or waves.

Light as a Direct Relationship between the Source and the Target

Essay XLV

Thus far, our discussion has concerned itself with what light is *not*, and we have shown prevailing scientific theories on the subject to be fundamentally flawed. However, we have not yet categorized light via its proper ontological designation, a feat possible now that prevailing fallacies have been swept aside.

It is instructive to take note of what we ubiquitously observe about light. First, light requires a *source.* There would be no light in the absence of stars, the Sun, light bulbs, candles, or some other *entity* that *emits* it.

Second, light requires entities to *reflect off of* in order to be perceived. Light, as it is originally emitted, is not visible in itself, but rather must come into contact with another entity in order for its *effects* to be perceived. The type of light that reflects off a given entity will determine how the entity is seen. For instance, white light reflected off a yellow wall will cause the wall to seem yellow. Blue light reflected off that same wall will cause it to seem black.

Furthermore, the *distance* of the light source from the target entity will determine how light affects said entity. A candle will render the entities closer to it more visible than the entities

farther away. It is also known that some sources of light (the Sun) are capable of illuminating at greater magnitudes and distances than others (the candle).

Thus, whatever light is, it is quantifiable not only in its *type* (i.e., whether it is yellow, red, etc.) but also in its *amount*. Additionally, as shown earlier, light does not require continuity of particles in order to propagate; it can overcome a vacuum – i.e., the absence of a medium. On the contrary, it seems that, the more dense the medium, the less receptive it is to light.

Light can propagate through gaseous media, and some liquids (such as water), but not through most solids. Knowing this information, which no individual could miss in the course of daily observation, it is possible to ontologically categorize light as a *relationship between the entity which emits it (the source) and the entity which it affects (the target).*

The nature of light as a relationship is evident in the fact that it takes an entity to produce and *another* entity to experience, thereby altering the qualities of the target entity and adding to it the attribute of visibility, among others. Since light is not a particle, it cannot simply be *sent* from one entity to another and *then* affect the target entity.

There is no "sending" of light, but rather the relationship is *directly* between the source entity and target entity, without any entities that must necessarily be intermittent for the relationship to occur. Light is the name for the *interaction at a distance* which the source and target entities undergo.

In that sense, there is quite a contrast between a wave relationship, such as sound, which requires the presence of billions of periodically vibrating molecules between the source and the perceiver, and light, which requires *only* the source and target entities. Though, like a wave, light is a relationship, in certain critical fundamental aspects it is as far removed from waves as relationships can get.

The Compatibility of Observations about Light with the View of Light as a Relationship

Essay XLVI

We have previously identified light as a relationship between its source entity and its target entity.

To specify what *sort* of relationship light is, ubiquitous observation can add that it varies inversely with distance (which physics has verified to be an inverse *square* relation), that it is capable of varying both in type and intensity, and that it is *the* relationship which allows observers to see entities.

Unlike sound, however, light does not *require* the observer, even though the observer requires light. The Sun continues to illuminate the entirety of the entities of Earth, even if a particular

observer happens to be indoors and thus lack view of the Sun, or the vast majority of entities which are affected by it.

The observer is merely a third party to the relationship, and his involvement in it (through the act of visual perception) is rendered possible by the primary interaction between the source and target entities.

Interactions among entities not spatially adjacent to one another are not, by the way, either inconceivable or in any manner philosophically excluded. A relationship only implies that multiple entities *affect* each other's qualities, not that they *contact* each other physically.

Indeed, physics has demonstrated that numerous "forces at a distance," exist, including magnetism and the electrostatic force, which need not necessarily imply contact between source and target.

Light, though not a force in itself, can nevertheless be classified as a relationship between two spatially separate entities without committing either a philosophical or a physical error.

The objection might be raised to this model of light as a relationship at a distance that it does not account for such apparently simple physical principles as the reflection and refraction of light, since, it might be claimed, only entities can reflect and refract.

However, in order for all the known regularities concerning reflection and refraction to be true, light *need not* be an entity in itself. The Law of Reflection, for example, essentially states, "If a source entity is located at a certain angle of incidence from the target entity, it will also exhibit the relationship of light with any proximate entity that would be located at an angle from the target entity symmetric to the angle of incidence with respect to the normal line to the surface." This law merely states *at which positions* the relationship of light will affect entities, and how it will affect them.

As for refraction, the only reason why such a phenomenon is even possible is because light has entered a certain *medium*, i.e., has obtained target entities which have their qualities altered by the light-emitting source.

One of the alterations in the qualities of the medium which is the target entity is the appearance of a bent "beam," which is not independent of the medium, or superimposed upon it, but rather a *visual manifestation* of the relationship between the source entity and the target medium. Neither phenomenon, to be explicable, inherently requires the model of light as consisting of particles in itself.

The Transmission of Light

Essay XLVII

Given that motion, along with its measure, speed, is a property of entities, and light is not an entity, it may be asked how this view of light is reconcilable with the conventional scientific notion that there exists a "speed of light", often thought fundamental in numerous post-Classical physical calculations.

At this point in the analysis, we should wish to neither advocate nor refute definitively whether or not the "speed of light" is a true or a false concept. Rather, we should determine whether it is a *feasible* one according to the ubiquitous truths we have hitherto explicated about light. If so, we should formulate a theory of *how* the idea of a "speed of light" might be explained by the understanding of light as relationship.

Furthermore, this approach will enable us to determine precisely which parts of Einstein's relativity-based ideas concerning the "speed of light" are in fact flawed and can be ruled out by cosmological examination.

Conventional scientific wisdom will tell us that light in a vacuum "travels" at some $2.998*10^8$ meters per second, a quantity that has seemingly been verified by observation and experiment. This simple but misleading expression reinforces further the fallacy that light is an entity capable of "traveling".

Since light is not an entity, it cannot "travel" or exhibit motion *qua* entity. A more appropriate word to use for the phenomenon of light emitted by a source entity "reaching" a target entity would be "transmitted." Light is *transmitted* from the source to the target, since transmission can occur with respect to other existents than entities.

For example, a sound wave, a relationship, can be transmitted from the emitting device to the listener. Though this implies the motion of entities that partake in the specific relationship, the entities themselves are not transmitted; the wave relationship is. This example is instructive in demonstrating that relationships can indeed be transmitted.

Furthermore, while waves are contact relationships, there exist non-contact relationships, as previously shown, and it is not inconceivable that such relationships can be transmitted at a certain rate. For instance, charging by induction does not occur instantaneously; it takes time, however small, for electrons to migrate from one pole of an object thus charged to another. Yet charging by induction is a non-contact relationship between the object that charges and the object that is being charged.

Since light is a non-contact relationship, and it is not impossible for such relationships to be transmitted, it is not impossible for light to be transmitted. The empirical sciences have suggested that such a transmission indeed exists, and this is perfectly within the bounds of rational cosmology.

Light's Distance-Dependent Rate of Relationship

Essay XLVIII

Since light is not an entity and thus cannot "travel" but is rather a relationship that can be transmitted, the idea of a "speed of light" can be rephrased as simply the idea that the relationship of light does not affect the target instantaneously, and is transmitted from the source at a certain rate.

The transmission of light is dependent on the distance between the source and target, which, as shown earlier, is also confirmed by simple ubiquitous observation of everyday phenomena.

The claim that there is a "speed of light" amounts to the assertion that *a source entity $2.998*10^8$ meters away from the target entity and in a vacuum will affect the target entity one second from the time light was emitted.*

The measure of this phenomenon, currently expressed in meters per second, is not truly a speed, but rather a *rate of relationship.* To be more precise, rational cosmology can assert the prerogative of renaming the concept of a "speed of light" to a *distance-dependent rate of relationship* (DDRR) which light does indeed exhibit.

Like all relationships wherein one entity acts upon another, light does not occur instantaneously. It is, like all relationships, structured so as to be fathomable via reason, and thus retains certain consistencies; the rate at which it is transmitted is constant given a certain constant medium separating the source and target.

When the nature of the medium changes, so does the nature of light's transmission and its rate. Since any medium absent a vacuum must by definition consist of other entities, the effect of light upon those entities delays the effect of light upon the original target entity. This is a proposition which logic itself would suggest even in the absence of in-depth particular observation.

Luminosity, that quality of the source entity which enables it to emit light, is finite in its measure in every entity that exhibits it. That is, no entity can emit an infinite amount of light at the same time.

If, between the source entity and the entity originally designated to be the target, there exist other entities, those others will have a fraction of the source's luminosity expended on them.

Furthermore, since the exhibition of any relationship, including light, takes some amount of time, the initiation of the relationship of light upon the farther target entity will be delayed due to the time it takes for the source entity to relate via light to the nearer entities of the medium between source and target.

Since every different medium implies some difference in the nature of its constituent particles, the interaction of a source entity of a given nature with various different particles will imply

various different effects dependent on the natures of the particles thus interacted with. For media of the same sort, the particles ought to be the same as well, and the source entity will interact with them in the same way, thus explaining why light always exhibits the same DDRR when transmitted through the same type of medium.

This deliberation should also suggest that, not only must light reach the target entity in a greater amount of time when traveling through some particulate medium than when traveling through a vacuum, but also that the target entity will be illuminated with the greatest magnitude when no entities occupy the distance between source and target, i.e., in a vacuum.

In a vacuum, all of the source's luminosity must be imparted to the target, since there exist no other entities to be affected by it. This is why light is seen to be best transmitted to other entities in a vacuum (and is seen to be transmitted quite well in air as well), and is transmitted the poorest through opaque solids, which have the most molecules arrayed between source and target in the most rigid fashion.

Measuring Light's Transmission

Essay XLIX

We have previously determined that what is commonly referred to as the "speed of light" is in fact a *distance-dependent rate of relationship* (DDRR) that depends on the medium between the light source and the target entity under consideration. Since the DDRR is not a speed, it is not proper to measure it in units of speed, such as meters per second.

Then how ought the DDRR of light be measured? It is true that light begins to affect an entity $2.998*10^8$ meters away from the source one second after emission, and that this proportionality holds no matter what the distance between the source and target.

However, to measure the DDRR in meters per second implies the fallacy that light actually *travels* through the medium separating source and target. Light does no such thing; it is manifested in entities and entities alone. Where there is an absence of entities, there is an absence of light. If there is no entity $1.499*10^8$ meters away from a source, there will be no light there, even if a half-second had passed from the moment of emission of light.

As earlier explained, the very occurrence of "beams" of light in particulate media is accounted for by the effects of the source on the many closely grouped molecules comprising the media. On the macroscopic scale of human vision, the result is perceived as a continuous "beam", when, upon examination on a narrower scale, it will be seen as an aggregate of discrete effects of light on each individual particle of the medium.

The best way to measure the DDRR is not, therefore, in units of velocity, but rather in an otherwise *combined unit of distance and time.* To state, for example, that a target is one light-second away from the source means that it is at such a distance away that it will exhibit light one second after light is emitted.

The unit, "light-second," like all other denominations of DDRR measurement (light-minute, light-year, light-millennium – all conceivably useful), implies within it the dependence of the time of light's exhibition upon the distance between source and target.

The very word "light-second" is shorthand for, "the distance separating a source and target such that it will take one second for the source to illuminate the target." This unit is *similar* to the unit for velocity in the sense that it involves both distance and time, but it does not involve them in the same respect as the unit for velocity, nor is it applicable to the same sorts of entities to which the unit for velocity is.

Why Light's Transmission Does Not Determine the Motion of Entities

Essay L

It has been hitherto shown that it is not only quite conceivable, but also necessary, that the relationship of light have a rate at which it occurs. However, this rate does not at all imply the *motion* of light or that light is an entity that can move or have a speed.

Yet Albert Einstein's Theory of Relativity is based on the assertion that, not only is light an entity that has a speed, but also that this speed is the only absolute in the universe, and that all of space and time are relative to this single "speed of light". Especially significant was Einstein's rejection of the notion that any absolute motion could exist aside from the "motion" of light, to which every other motion is relative. Einstein also postulated an idea held by subsequent physics as sacred, that no entity can travel at a faster rate than light "travels".

For refuting the foremost idea, that of the "speed of light" as the only absolute, it will suffice to refer the reader to the entirety of the present treatise up to this point. It has already been shown that all entities must have ubiquitous qualities which are quite absolute and, moreover, prior to and independent of any particular phenomena.

Furthermore, in Essay XXX: "The Nature of Motion" it has been shown that not only is all motion absolute, but that the absolutism of motion is a necessary precondition for accurately understanding which entity is actually in motion.

If the position of Entity A changes relative to that of Entity B – say, in that A and B are now closer than before – it still remains to be explained whether A moved toward B, or B moved toward A, since the implications of each answer are almost always quite different from those of the other.

Thus, the DDRR of light, while it may be an important phenomenon, and perhaps indispensable for understanding the behavior of the ubiquitous relationship known as light, is not necessarily a determinant of the other qualities and relationships exhibited by an entity.

An entity's time, for example, is independent of its motion, or any other physical change it undergoes, even though the concept of time is needed to define and understand motion in the first place.

Similarly, a source entity's DDRR is independent of its other physical qualities and relationships – such as mass, volume, the spatial dimensions, *or time and motion* – even though light (along with the manifestation of a given DDRR for such a relationship) is needed for human observers to visually perceive entities in the first place.

An entity in the dark, and unperceived, continues to exhibit the same mass as before, provided it was not altered in other ways. It continues to accumulate time uniformly, no matter what else happens to it. Existence exists independent of the observer, and every concept in it ought to have its applications delimited to include only its proper referents.

The DDRR is a tool for explaining the behavior of light and everything pertaining to light. It does *not* account for anything outside of light and pertaining to the remainder of the universe.

Why There is No Inherent Limit to Motion in the Universe

Essay LI

We have previously refuted Einstein's mistake in asserting that no absolute motion could exist aside from the "motion" of light, to which every other motion is relative. For the second Einsteinian fallacy, that nothing can "travel" faster than light, a logical refutation will, again, suffice.

It has been shown that light does not "travel." Light and motion are quite distinct phenomena, each independent of the other. Thus, the fact that the relationship of light exhibits a fixed nature in specific media, as it logically should, has absolutely no bearing on what motion may or may not occur on behalf of entities.

Just as time is independent of mass, so is motion independent of light. The fact that an entity weighs two kilograms does not limit how long it can exist. Neither does the fact that an entity can emit light to affect a target entity $2.998*10^8$ meters away from it in one second (at least) preclude that entity, or any other entity in the universe, from moving at rates as large as their natures allow.

It ought to be recalled that the universe has no inherent qualities or relationships *qua universe*. Thus, it also cannot have "built-in limitations" on the behaviors of entities, except as ordained by the particular natures of the entities involved.

An entity's mass, volume, or spatial expanse can conceivably limit how fast it can travel. Every entity in existence has limitations on its motion, defined by the constituent qualities of that entity and the medium through which it travels. However, there can be no limitations on how fast anything can move aside from that thing's own capacities and surroundings.

Thus far, all the entities observed in the universe have not been able to reach rates of motion beyond the alleged "speed of light", because their natures restrict them to this extent. Not even human technology has yet produced entities capable of attaining velocities in excess of $2.998*10^8$ meters per second.

Therefore, Einstein's suggestion seems outwardly plausible, because it has not yet been empirically disproved. But such a support for it is specious, since, simply because an idea has not been empirically demonstrated false, does not imply that it has been proved conclusively.

Indeed, the day on which man designed the first machine to exceed the alleged "speed of light" would be a glorious day that would conclusively refute Einstein's view on this issue. Whether or not this *will* happen is an open question. Here, we can only conclude that it is *not impossible* for such a machine to be invented.

The Dangers of Positing a Universal Speed Limit

Essay LII

The logical arguments on which rational cosmology is based all tend toward a rejection of Albert Einstein's blanket assertion that no entity can travel faster than $2.998*10^8$ meters per second as unsubstantiated by fact and unwarrantedly claiming omniscience. There are other reasons to reject Einstein's view, however, for this view is damaging to human aspiration and to man's conviction in the efficacy of his accomplishments.

Einstein has essentially stated that, no matter what heights of ingenuity man might reach, no matter what physical qualities he might impart upon the entities he designs, he will never be able to surpass some arbitrary speed barrier, imposed, not by the natures of the entities that he has designed to move, but by a collective designation (the universe) wrongly viewed to have any properties in itself.

The harm of Einstein's error is seen less in immediate physical impacts as in the deleterious effect on the mindset of individuals, who thereby come to think that all their efforts to improve their lives will ultimately be capped by some non-entity-based, non-quality-based limit beyond their control.

Just as the doctrine that the entirety of existence will someday end debilitates man, because it reduces the ultimate purpose of his actions to futile nothingness, so does the idea of an insurmountable "cap" on motion inhibit him, posing before him the specter of an inevitable eventual terminus to his ability to accomplish.

In fact, though this will likely not occur for some time, it is quite *conceivable,* whatever the mechanics involved in this feat might be, that some vehicle might someday be devised that would travel at a faster rate than the rate at which the relationship "light" occurs.

This will bear some interesting physical implications, such as the fact that an entity that departs from a source of light to a target will reach the target earlier than the target can become illuminated by the source.

Indeed, this traveling entity will, unless illuminated by other light sources, remain incapable of being seen by observers at the source during some portion of its motion.

However, just because a phenomenon cannot be directly seen, does not mean that it cannot occur. Just because motion under certain circumstances cannot be visibly observed, does not mean that it does not happen, nor that we cannot employ other, less direct, indicators to verify and fathom its occurrence.

Because there is nothing inherently impossible about "motion in the dark", there is nothing inherently impossible about travel faster than $2.998*10^8$ meters per second. The limitation to such travel is technological, not cosmological.

Color as a Property Intrinsic to Entities

Essay LIII

Now that the cosmological underpinnings of the phenomenon of light have been explained, it is possible to rationally analyze the type of existent that the concept of "color" denotes.

It is ubiquitously known that not all entities react to light in the same way. Aside from an entity's spatial contours and motion, the entities that light illuminates exhibit another property that allows some of them (or parts of them) to appear differently than do others to the observer.

This is a property intrinsic to the entities, even though light is needed to make it accessible to the eye, as demonstrated by the manner in which this property will be exhibited given various types of illumination.

A ball called "red" will appear red under white light, black under blue light or green light, and red under red light. Physics has explained this to mean that the ball absorbs blue and green light (and any combination thereof) and reflects red light into the eye of the observer. Whenever red light is present, the ball will reflect only red light, and only of a certain specific "wavelength" (a misnamed unit, as previously explained) that denotes the "shade" of red the ball possesses.

The ability to reflect only red light is a property possessed by the ball, independent of what sort of illumination it is presently subjected to. Other balls might be blue or green, and thus have entirely different abilities to reflect only blue or green light, and not red light, as the former ball. Other balls still might have the ability to reflect two fundamental types of light and therefore be colored violet, or yellow, or orange, or to reflect all light and therefore be colored white.

This difference among the balls cannot be explained by merely stating that they are subject to the same, or to different, types of light. Color is thus not a relationship, as no other entity is involved

in determining it other than the entity exhibiting it (within the given frame of reference, which treats each ball as an entity in itself). Rather, color is a *quality,* i.e., that which an entity has and is measurable, via the electromagnetic spectrum.

Color is different from sound in that, while sound *requires* an observer (a listener) to be fully manifested, color does not. The quality of "the color red" merely informs us that the entity is capable of reflecting only red light. In total darkness, the observer will not be able to see the red entity, but the entity will remain capable of reflecting only red light nonetheless, even though no red light currently exists for it to reflect.

Since color is existentially independent of illumination, it is not dependent on being seen to exist. The ability to reflect red light, when red light is present, does not change when different types of light are present.

It is instructive to note that this definition of color as a quality intrinsic to entities means that an entity's color does not necessarily equal its *present appearance of color* – i.e., its appearance under the light that happens to be emitted by an available source. A black entity (which does not reflect any light) is quite different from an entity that simply *appears* black merely because the type of light it has the ability to reflect happens to be absent.

The true indicator of an entity's color is its appearance under white light – i.e., light that combines all measures of the electromagnetic spectrum and thus necessarily includes all the types of light the entity could possibly reflect. Thus, it is always possible to objectively know an entity's color by illuminating it with white light, even though the illumination itself does not equal the color.

Chapter VIII
Forces

The Nature of Forces

Essay LIV

Now that we have explicated the relationships of position, motion, and acceleration, it would be fitting to offer a cosmological examination of the concepts frequently employed by theoretical physics, both of the Classical and post-Classical variety. The idea of a force is correctly used by Classical physics to explain the cause of acceleration within the bounds to which physics can rightfully be constrained.

The simplest definition of a force is also the proper one: a force is a *push or a pull.* Of course, there can be no action, such as a push or a pull, without the entities which originate it. Thus, the cosmological implication of this definition is that *a force requires an entity to originate.*

Also, there can be no push or a pull without an entity which is pushed or pulled. Thus, *a force requires an entity to be exerted upon.* From all these deliberations, it can be inferred, of course, that forces are *relationships,* since they require multiple entities to be manifested but are not entities in themselves.

In his capacities as a physicist, Sir Isaac Newton postulated his Second Law, that the net force acting on an object is a product of the object's mass and its acceleration. All entities have mass, as mass is one of the ubiquitous qualities of entities.

Cosmologically, this implies that an entity which is accelerating must have some magnitude of force exerted on it. Since a force can only be exerted by an outside entity, this means that *an entity requires another entity to accelerate it or to keep it accelerating.*

While the involvement of other entities is not required for something to stay in place or move at constant speed, acceleration of anything necessarily implies the activity of some entity external to that which accelerates.

This statement applies equally to mechanical systems that, when taken in whole, cause acceleration to occur within themselves. These mechanical systems are always composites, made up of smaller entities. It is these constituent entities that exert forces on one another to produce the accelerations necessary to such a system's operation.

Though, when the whole system is considered to be an entity, it does not necessarily receive an outside force, it is always necessary to remember that *at some permissible reference frame,* one will encounter discrete entities exerting forces upon one another in any system.

For example, a rocket that moves on the basis of expelling its own fuel does so in accordance with Newton´s Third Law. An action force by an entity (the fuel) causes an equal and opposite reaction force to move another entity (the rest of the rocket after the fuel has been expelled). As will be seen in subsequent essays, this insight concerns systems of every level of complexity, including living, volitional ones.

How Forces Originate

Essay LV

Some might object to the theory for the interpretation of forces previously explicated by claiming that it explains only what forces result in and what components are involved in their operation.

These objectors would argue that there is insufficient explanation of what causes a given force to arise in the first place. Surely, an entity cannot simply spontaneously "decide" to exert a force on another. The beginning of the answer as to the cause of the force's exertion can be found in Newton's Third Law.

Surely, the greatest merit to Sir Isaac Newton's work has been the rigorous consistency that he maintained between his work as a physicist and philosophical objectivity, such that no absurdity nor any violation of common sense can be found in any of his models and discoveries. Similarly, his Third Law illustrates a cosmological implication that we observe every moment of our lives, yet which few have dared to explicitly phrase.

According to the Third Law, for every force Entity A exerts on Entity B, Entity B will exert an equal and opposite force (i.e., a force in a direction 180 degrees from that of the first force) on Entity A. There is no time gap between these two force exertions; they occur simultaneously with one another, and both forces are initiated *at the same time.*

This raises the question as to which entity in this pair is the agent of the force, and which entity is the one being acted upon. The answer to both questions is, *both of them.* A and B are both originators of the force *and* its recipients. The reason for *why* the force exists and is exerted needs not be found outside the system of the two entities in question.

The cause of all forces between two entities is the interaction of the natures of the two entities involved, nothing else. One entity does not start the interaction, and the other entity does not follow up. Such terms are inapplicable when discussing how forces come about. Rather, the initiation of a force is a single *summary action,* in which both entities simultaneously partake and which is caused by the *combination* of both entities´ properties placed in a certain spatial proximity.

In the anatomy of an action-reaction pair, one will find that two distinct forces are always involved, the force of A on B and the force of B on A. Each entity, as a result of its distinct nature, experiences a distinct force from that experienced by the other entity (though of the same magnitude), but the *exertion* of the forces is a process that goes both ways, a single process that, for the purpose of analyzing the effects on the participant entities, can be mentally separated into the component forces of an action-reaction pair.

Why There is No Prime Mover

Essay LVI

The action-reaction force pair between *two* entities is the most fundamental acceleration-causing interaction there is. Every multi-entity process involving forces, no matter how complex, can always be interpreted as a set of action-reaction force pairs.

To illustrate, three similarly charged metal spheres arranged in a triangular shape and touching one another will be repelled simultaneously in what seems to be a single process. However tempting it might be to attribute this phenomenon to a single force "triple", the repulsion will in fact be the result of three force pairs – the pairs involving, respectively, A and B, A and C, and B and C.

Thus, it is true of all force relationships that they occur between two entities, that each entity involved both originates a force and is affected by one, and that this mode of interaction is the root of all acceleration in the universe.

As brilliant and worthy of admiration as the deliberations of Aristotle might have been, they were not error-free. One of the cosmological fallacies espoused by this thinker was the idea that all motion and acceleration in the universe could ultimately be traced to a single "master" entity, the so-called prime mover, which had originated the motion and acceleration of all other entities.

Subsequent theologians have made the argument that the Aristotelian prime-mover function is fulfilled by God, and have used Aristotle's reasoning to support their theism. While this is one of the *least* egregiously flawed religious viewpoints, it nonetheless deserves to be addressed here, as it is a cosmological claim, and an analysis of the proper nature of forces will refute it.

We have seen that a system of two entities of a proper nature requires no forces external to it to bring about the acceleration of its constituents. Since the fundamental origin of all forces is within two-entity systems in which action-reaction pairs arise, this is where our causal chain can stop, with no need for the origin of acceleration to be traced to some outside "prime mover."

Furthermore, because we observe multiple two-entity pairs originating forces, we can conclude that *forces have no single central origin.* Rather, the beginnings of all forces are as localized, numerous, and diverse as the number of two-entity pairs that have ever interacted in a manner that gave rise to acceleration.

This is further reinforced by the truth that the universe is not a single entity, nor do all the entities in the universe behave in a coordinated fashion according to some "master plan". Rather, they act in accordance with their own individual natures, and interact accordingly, with neither need nor possibility for a master mechanism that could coordinate such varied and discrete entities so as to have a single overarching effect upon them.

The Model of Force Fields

Essay LVII

A common proposition put forth by physicists with regard to many fundamental forces which occur at a distance – be they gravitational, electrical, or magnetic – is the idea of a "field" created by an entity which is capable of exerting a certain type of force.

When interpreted correctly, this idea is quite useful and cosmologically correct, yet great mistakes have been made with regard to it, especially by empiricist-positivist post-Classical physicists who have decided to ignore philosophy and treat fields in a manner that yields evident logical contradictions.

The mistakes in the interpretation of fields are fundamentally philosophical, yet they have resulted in whole absurd *physical* theories, including scores of imaginary massless particles

thought to be responsible for certain types of fields, invisible lines which cover all of the universe and are more than the paper models they ought to be, and the multiply flawed idea that a single electric charge somewhere can instantaneously bring about a change in the entire "universal fabric".

Before discussing what a field is not, however, we should first discover what a field is. A hint to the answer can be found in the fact that the common derivation of the very concept involves the use of a "test particle", either of a given unit of mass or a given unit of charge, which is placed a certain distance from a force-exerting entity.

The force exerted upon the test particle at this position becomes known as the strength of the field at said position. That is, the idea of the electric field merely concisely expresses the knowledge that *for every unit of mass, charge, etc., at this location, a force of X Newtons will be experienced, where X becomes the magnitude of the field.*

The direction of the field is also derived by examining the nature of a given test particle. All gravitational forces attract; thus, any test particle's direction in a gravitational field will be toward the other massive entity.

For electric fields, the test particle is *assigned* a charge, usually positive, and the behavior of a particle so charged then becomes the convention for which way an electric field will be directed at any given location. Thus, the direction of the electric field at a given point is merely *the direction in which a particle with the same nature as the test charge will accelerate when a force is exerted upon it at the point.* There is nothing here which requires defining the field as an entity in itself.

Why Force Fields are Abstractions Only

Essay LVIII

From the way in which the model of force fields is arrived at, it can be inferred that even the very process of *defining* an electric field depends on the use of two entities – the entity which exerts a given force and the entity upon which a force is exerted. (Of course, the test particle also can be described as having its own field, which affects the original field-exerting entity.)

Additionally, the model of a field only has *physical consequences* when an entity is at a given point which the field is said to encompass. That is, when an entity is present "within the field" of another, there is a force exerted. When no such entity is present at a given point "within the field", all that the field model describes is a *potentiality,* a knowledge that, *if* an entity of a given nature were there, it would have a given force exerted upon it.

This is useful knowledge to have in order to anticipate positions and behaviors not yet in existence, and the field idea provides convenient symbols and shortcuts to expressing it.

However, this model should not be mistaken for an actual physical existent. The only actual existents are the entities themselves and the forces that they exert. When there is no entity for the field-exerting object to act upon, there can be no force, and the field remains only a convenient abstraction without any physical existence in itself.

A field *qua* field is neither entity nor quality nor relationship. It is just an *intellectual tool* for describing an actual relationship, that of force. All the symbols and diagrams associated with fields are also just reliable predictors of entity behavior. The commonly used "field lines" are a visual expression of both the magnitude (via the lines' proximity) and direction of the force a given test particle will experience at a certain location "within the field", as well as the trajectory that the test particle will follow at that location.

Yet these lines are not actual physical entities. They are not invisible "roads" that a particle will follow; they are not "woven into" the "fabric of the universe". They are just descriptors of a behavior made possible by the presence of entities of a certain type in a certain proximity with respect to one another.

The model of force fields has done useful service in physics, and it ought by no means be discarded. It must simply be put in its proper place as an abstract tool to aid human cognition of real entities but not in itself an entity, quality, or relationship.

The Impossibility of Non-Local Effects

Essay LIX

Before continuing our discussion of fields, it will be fitting to explore a broader concept which will then be applied to further analysis. This concept is at the root of nearly all the fallacies which empiricist-positivist physicists perpetuate about fields; it is the assumption that such a phenomenon as a *non-local effect* could conceivably exist.

A non-local effect is one that involves not only a limited number of participating entities, but the entirety of the entities in the universe (and, in the mistaken view of empiricist-positivist cosmologists, the universal "fabric" in which these entities exist). An entity which exhibits such an effect is presumed to thereby affect everything else that exists, instantaneously and simultaneously.

However, as will be recalled from Essay XVIII: "The Existence of Change and the Necessity of Time", all change requires time to take place, and any effect an entity creates implies some change in the entities it affects. A non-local effect, concerning everything as it by definition must, must also therefore occur instantaneously, so as to encompass the entire universe at once.

Thus, a non-local effect presumes the occurrence of vast changes of a universal scope without any *means* for the changes to occur – i.e., without the accumulation of time. We therefore know the idea to be false, since *any* change, and therefore any process, requires some amount of time, however small, to accomplish, and the more entities a given process will affect in the same

manner, the more time will be thereby expended in the bringing about of the effect, since the entity originating the process must spend some amount of time affecting each of the entities which the process targets.

Thus, a process which is to have some impact on every entity that exists will need to take *an extremely long time* to be completed, as compared to the time in which that process would affect only a single entity.

As soon as we admit that it would take time for a non-local effect to occur, we thereby admit that it must be a local effect! A given entity affects another, then another, then another, and so on for quite some time, and at every instant during which this process functions, the effect is quite local; only a limited set of entities has been affected – i.e., the entities in which it is easiest for the process-originating entity to bring about changes first.

It is true that some entities can, under certain circumstances, affect several others simultaneously and in parallel – as a light bulb will do to two objects the same distance from it – but every entity's resources with which to undertake this simultaneous effect are limited. While the light bulb's luminosity allows it to illuminate a large number of objects in its vicinity, its resources are not nearly of the amount to similarly illuminate every entity that exists.

Contradictions in Considering Force Fields as Things

Essay LX

Here, we explore the logical absurdities evident in viewing force fields as entities in their own right, rather than simply models or abstractions.

The idea of a field as an entity in itself inevitably entails the assertion that it exerts a non-local effect. Most force fields are known to be inversely proportional to distance (or the square of distance) between the entity which is said to originate the field and the entity which is said to be affected by it.

However, no matter how large the denominator of the field expression becomes – i.e., no matter how large the distance of separation between the two entities – the magnitude of the field never reaches zero. That is, according to the field-as-entity model, the field must exist *at all distances* from the entity which originates it, no matter how great, and must therefore encompass all of existence instantaneously and simultaneously, as it is assumed that the field would be established as soon as the originating entity acquires a given mass or charge.

The field-as-entity would also need to have infinite measurements in all three of the spatial dimensions, since it would be able to produce effects at any distance, no matter how great. Not only is the idea of an entity having limitless measurements of any quality a logical contradiction, as shall be subsequently seen, but this model also brings about the absurdity of trillions of such infinite field-entities occupying the *same* space, since multiple entities are observed to originate multiple types of fields!

But A is A, and it is impossible for multiple entities (when none of the entities are constituents of the other entities) to occupy the exact same spatial position at the same time. Thus, being contrary to reality and logically in error, the model of a field as an entity in itself must be rejected.

Indeed, under the view of fields as entities, *all* fields would need to simultaneously occupy *all* space, thus obviating the possibility of distinguishing among the various fields and their effects. If all fields are everywhere, it is impossible to say which field affects what. But if fields are recognized as mere abstractions and most often expressions of potentiality rather than actuality, then this absurd scenario need not take place.

Indeed, it is possible for the same entity to be affected by a multiplicity of fields, but this logically reduces to the simple and comprehensible proposition that multiple other entities are exerting forces on the entity in question. If force fields are seen as models or potentialities rather than as things in themselves, our conceptual framework again becomes consistent with the commonsense universe of our ubiquitous observations.

The Impossibility of Infinite Force Exertions

Essay LXI

Even if a field is not an entity and non-local effects cannot exist, how is it possible to explain the seemingly non-local effect of the field-originating entity needing to exert forces of some magnitude, however small, on the entirety of the entities in the universe in order to be in accord with the equations describing the potentialities for force exertion in a field?

In truth, it is impossible for a single entity to act on absolutely everything else that exists, and this fact can be accounted for by including certain caveats to the use of field expressions.

A given field expression is accurate only for a given instant; since fields involve the exertion of forces, and forces cause acceleration, the concept of a field is inextricably tied to the *movement* of a particle said to be within a field. As soon as the particle begins to move, it is no longer at the same position at which it has been previously, and a different expression now applies to describe type of force which it experiences.

Similarly, if the entity said to be "within the field" now experiences a different force, so does the field-originating entity, since it, too, partakes in the action-reaction pair. No entity that exerts a force on another can remain static itself. As the field-originating entity changes its location, so does the nature of the "field" it generates change, and this nature is changed to a far greater extent by closer entities to the entity which originates the field than by entities farther away. Therefore, no field which has any actual physical consequence can remain constant for more than an instant.

Furthermore, the model of a single isolated field presumes that the entities extremely far from the field-originating entity are affected solely by that field. In fact, these entities have many others

close to them, which exert far more powerful forces to determine the behaviors of those entities. This is a practical argument which would lead one to think that the exertion of an extremely small force on an entity extremely far away could well be considered negligible, as far as any legitimate human interests are concerned. However, an even more powerful argument exists for the impossibility of non-local effects in the exertion of forces.

An entity, depending on its nature, has only so many actions that it can perform simultaneously and in parallel. It cannot occupy itself with an infinite number of activities simultaneously, since it has limited measurements of all qualities, and is always constrained by those measurements, of whatever magnitude and whatever sort they might be.

No entity could possibly have a sufficiently large amount of measurements of any quality required to affect all the other entities of the universe, for the sum of these measurements would need to equal at least the sum of the measurements of the rest of the entities of the universe, and this, by definition, is impossible, since the universe is the sum of all that exists.

While we do not rule out that it is feasible for entities to exert extremely small, even negligible, forces on other entities extremely far away, we can by no means interpret this to mean that every entity produces an active, non-local force effect on every other entity. Only under certain circumstances (i.e., those of a given degree of spatial proximity) and given certain natures of the entities involved, can forces result.

The Non-Existence of Gravitons or Other "Force Particles"

Essay LXII

One further fallacy about fields that deserves to be addressed here is the idea that non-contact forces (and thus the field models which apply to them) can be explained by the presence of special types of "particles" which are responsible for the motion of entities in a force field.

Apparently, some physicists have rejected the very possibility of non-contact forces and have instead tried to explain this phenomenon by inventing entities, such as "gravitons", that make direct contact with the entities they are supposed to exert forces on, and thereby result in acceleration.

Cosmologically, this cannot be, as such entities would need to be massless (especially in the case of "gravitons", which would otherwise themselves be quite significantly affected by the force of gravity), and mass is a ubiquitous quality of entities.

Additionally, an entity without mass cannot exert a force, since by Newton's Second Law, a force can only exist where both a mass and an acceleration exist. Furthermore, this notion ignores the far better verified Classical idea of action-reaction pairs.

If the Earth "sends" gravitons toward an approaching spaceship, the gravitons' pull on the spaceship might explain the force the Earth exerts on it; it would not explain the force the

spaceship exerts on the Earth. This would be so, unless the spaceship were to send out an equal and opposite stream of gravitons at the same time as the Earth, wherein the question would arise as to how these two entities were able to coordinate this exchange with such tremendous precision, how their gravitons are made possible in the first place, and whether each entity has an inexhaustible number of gravitons, or whether it spontaneously stops exerting or experiencing gravity once it runs out of gravitons.

Far more fundamental notions, belonging both to cosmology and Classical physics, refute the idea of massless "particles" causing non-contact forces, thus rendering the idea false. To add to this, the idea might be declared moot by Occam's Razor, since, as earlier explained, the two entities involved in the action-reaction pair are quite sufficient to account for how forces originate.

The idea of gravitons arose as an implication of a fundamental philosophical error: the view of fields as entities in themselves and the view of field lines as literal "roads" along which particles can travel. Accepting that error, some empiricist-positivist physicists attempted to use it to "explain" non-contact forces as contact phenomena made possible by these "roads" and particles such as gravitons traveling along them. Yet this does not save the view of fields as entities. Rather, in this case, one initial error has led to a second even more mistaken view.

Chapter IX
Mistakes Concerning Infinity

Infinity and Existence

Essay LXIII

"Infinity" is one of the most frequently encountered terms in the contemporary culture, and one of the least understood. Too often has its invocation been an attempt to justify mysticism, irrationalism, and contradiction, especially in the natural sciences.

It is the province of philosophy, as a foundational science, to set the very *framework* without which the natural sciences cannot operate. Unfortunately, numerous contemporary scientists have stepped far outside their fields in making generalizations about the nature of existence, and of infinity – deliberations which properly belong in the realm of philosophy and which philosophers must employ to weed absurd and contradictory statements from the specific-observational sciences.

Reality is absolute, and every existent has an identity. According to the philosophy of Objectivism, existence and identity are inextricable corollaries. To be is to be *something* and to be *something in particular*. To be something in particular means to have a specific, deliberate, fathomable nature.

It is no coincidence that the word "to fathom" means both "to measure" and "to understand." In order to be understood by man, a given entity must have attributes that can be *measured on some scale,* be it a qualitative or a quantitative one. In order to be measurable, an entity must demonstrate a *finite quantity of each measurable attribute.*

A particular given entity – say, a dog – must have finite mass and length, and its fur must reflect light of a finite measurement. A concept, such as *dog,* is formed by omitting the particular measurements of every dog and claiming that a dog must have dog-like qualities *in some quantity,* but could have them *in any of a range of quantities.*

To claim that any dog has *infinite measurements* of given qualities is absurd: if something is infinite, and does not *have* a set, delimited quantity to be measured, how can it be measurable? If it is not measurable in *some manner,* absolute or relative, how can it serve as a necessary quality in the definition of a concept?

Thus, infinite – that is, *limitless* – measurements of qualities cannot exist if concept formation is to continue to maintain its legitimacy. We shall call the coexistence of infinite and finite measurements or the presence of all infinite measurements within an entity a *simultaneous infinity.* Simultaneous entities are not to be found in reality; indeed, they are not even consistently conceivable to the human mind.

Using this as a foundation, we can now proceed to investigate prevalent misconceptions and faulty logic in the examination of the notion of infinity and where it is applicable.

The Possibility of Eternal Existence

Essay LXIV

Having previously explained the impossibility of simultaneous infinities, we proceed to refute some commonplace errors regarding the idea of infinity. It is frequently said: "If nothing can be infinite, then everything will have to be destroyed someday."

This in no way follows from the assertion that no entity may ever have an infinite quantity of anything.

Let us say that an architect has designed a tower of such durability that no known substance can erode or puncture it. There is absolutely no guarantee that this tower will ever be destroyed. It can be said to be invincible, but it will always have a *finite age!*

After one thousand years, the tower will be one thousand years old. After one million years, it will be one million years old. No matter how old it becomes, its age can still be *measurable,* and thus is not infinite.

Thus, it is possible for things to last *indefinitely,* and there is no inherent guarantee that everything will someday be destroyed. While man's mind cannot envision infinite size or infinite

smallness, it can conceive of the possibility of "infinite" *longevity* of anything: buildings, planets, animals, men – so long as these entities had a certain origin in time.

This phenomenon can be referred to as a *chronological infinity,* though I use this term with reservation, because it does not truly describe an infinity, for all the measurements concerning it must be in all cases finite. The true infinity, or a *simultaneous infinity,* concerns either coexistence of infinite and finite measurements or the presence of all infinite measurements within an entity.

God has been defined by the religious as an object of allegedly infinite quantities of everything – i.e., omnipotence and omniscience. However, the rational man would need to reject God *by this definition,* because it implies a simultaneous infinity. The technique of measurement-omission cannot be applied to the formation of the concept "God", and thus "God" cannot be a legitimate concept unless it is a hypothetical God that *does* have a finite age, and exhibits delimited qualities and abilities. (And, simply because something is *conceivable,* does not guarantee that it *exists*; the existence of such a conceptually legitimate God would still need to be *proven* in order to be within the realm of reason.)

Indeed, the recognition that "chronological infinities" can indeed exist ought to convey great hope to man; it implies that there are no cosmological or metaphysical limits to how long any entity, including a human being, can continue to endure. Most importantly, there is no inherent "built-in" restriction on the human lifespan, and what keeps us from leading eternal lives is simply the insufficiency of present technology, which can someday be overcome.

The Impossibility of Singularities with Infinite Density

Essay LXV

It is commonly asserted by some contemporary scientists that singularities and black holes exist which have an infinite density.

Philosophy must urgently employ its veto power over the specific-observational sciences to refute this illogical theory. Density is the ratio of mass per unit volume. An infinite density implies the existence of *unlimited* mass within a *limited* volume. Mass is not a chronological attribute, and exists all at the same time. To claim that infinite densities can exist is to acknowledge the existence of simultaneous infinities, which immediately renders one's concept or theory illegitimate.

One must ask the contemporary physicists the following questions: "What properties does a finite volume have to enable it to hold infinite mass without expanding? If a finite volume can hold any quantity of mass, no matter how large it is, does it not follow, then, that each individual unit of mass must occupy *zero* volume? If one unit of mass has zero volume, and zero multiplied by *anything* remains zero, then must a singularity, too, not have zero volume? But how can it also be claimed to have a certain *finite non-zero* volume?"

This is a contradiction that cannot be reconciled. The physicist, if he thinks rationally, will be impelled to admit that the singularity does indeed have zero volume – that is, it does not exist.

It is conceivable that an object may have a *very high* density, exhibiting a *very large* mass-to-volume ratio. It is also possible that there exist what are now called black holes and singularities, and that they can explode outward or attract matter into themselves.

But a "singularity" can only release some *very large amount of matter* in an explosion; it cannot be an inexhaustible fount of matter. A "black hole" cannot be said to have an infinite holding capacity for objects, either. Throughout its existence, it must have attracted *some finite quantity* of objects into it, which quantity affects its mass. But, if it also has some finite density, any intake of matter must also have amplified its volume in some manner. Even if this matter were to become compacted to an immense extent in the "black hole", it would not be possible to compact this matter *infinitely.*

This is what philosophy tells us in regard to contemporary cosmology. It informs us what propositions *must be false,* but it does not guarantee that even a conceptually feasible notion of black holes and singularities is *true.* Such demonstration would be a task for empirical observation to undertake. Philosophy can, however, catch scientists making senseless generalizations and propositions, and inform them whenever they venture into a realm for which the philosophically unsystematic scientist is quite ill-equipped.

Why the Universe Has No Finite Age, Nor Any Age Whatsoever

Essay LXVI

It is often said that if any entity must have a finite age, then the universe must also have originated at some point in time. This is a mistaken view, as an analysis of what is meant by the term "universe" can show.

It is true that any entity must have a finite age at any point in time. The mistake here, however, is quite simple: the universe is not an entity! It is a mere collection of everything that exists.

The purpose of the term "universe" is to serve as intellectual shorthand that substitutes listing every single existent when one wishes to speak of *universal* principles that are applicable to everything (such as the axioms of existence and identity). The term "universe" is not in itself a legitimate concept. If the sum of Chicago, Quasimodo, a telescope, and a hippopotamus cannot be a legitimate concept, how can the sum of Chicago, Quasimodo, a telescope, a hippopotamus, and everything else be a legitimate concept?

If one were to say that Chicago, Quasimodo, a telescope, and a hippopotamus had a certain single origin in time, the statement would evidently be ludicrous, from any perspective. The more expansive such a statement becomes, however, the more reverence is given to it in contemporary academia! Rationally, though, it must be all the more ludicrous for it.

There is no such one thing as "everything", nor even "the potentiality of everything". If there is no such one thing, it cannot have a single origin in time. (It cannot, *per se*, have any quality, not being a single thing!)

Thus, all the contemporary speculations about a Big Bang that occurred to "initiate everything" and a Big Crunch to occur that will "destroy everything" are sheer blunders, caused by the inability to understand the limitations of a term such as "everything" (or its equivalent, "universe".) Philosophy instructs the rational man to reject these fallacies right away.

The universe cannot have a beginning or an end, for the term "universe" is synonymous with "existence". Existence exists. Existence can never not exist or not have existed. A=A.

Every entity has some temporal origin, but it need not be the same temporal origin as any other entity. Furthermore, no entity need necessarily ever cease to exist, though some do. The vast majority of entities that cease to exist do so at different times from those at which other entities cease to exist. Thus, ubiquitous observation refutes the idea that all of existence must have some single time or origin and some single temporal end.

Why Matter Cannot Be Infinitely Divisible

Essay LXVII

Here, the insights of rational cosmology will be used to refute the view that matter is infinitely divisible.

I could take a sheet of metal and slice it in two pieces. It could be said then that the metal is divisible by two. I could, using advanced futuristic technology, dismember it into its constituent atoms. It can then be said to be divisible by about $6.022 * 10^{23}$ (assuming we have a mole of metal to begin with). I may also be able to extract the cores of these atoms and separate them into their constituent nucleons, and, subsequently, split those nucleons into the quarks that comprise them.

Matter can be divisible by a *very large factor*, and this factor may be far greater than we presently even suspect. Only the specific-observational sciences can inform us of the precise extent of matter's divisibility. But can matter ever be *infinitely divisible*?

Can we ever have an *infinity* of particles originating from some *finite* object? Just like having infinite mass in a finite volume, this is a simultaneous infinity, and is thus impossible. After all, this would imply that each of these particles would have zero volume, and would thus simply not exist. How one can form an existent piece of metal out of non-existent particles, no matter how many of them there are, is beyond rational comprehension.

Thus, matter *cannot be infinitely divisible.* We do not know the *extent* of matter's divisibility, and we may be able to continue dividing it for vast periods of time, and still find new division to be possible. But we will only *know* matter to be divisible as far as we will have divided it. Since

simultaneous infinities cannot exist, we will never reach a state where infinite divisibility can be empirically verified. Thus, it is not a legitimate proposition, scientifically or philosophically.

Another mistake related to the proposition that matter is infinitely divisible is often expressed thus: "Division by zero gives infinity. Therefore, infinite quantities must exist."

There is no such operation in the real world called "division by zero." I can split a pie into three pieces, or five thousand pieces (if I have a microscopic cutting tool). I cannot split it into *zero* pieces. Matter does not originate *ex nihilo,* nor can it be *annihilated*. The fundamental constituent quality of that which exists (i.e., matter) cannot all of a sudden *stop* existing for no apparent reason. The scientific principle of matter conservation is in fact a *philosophical* proposition which *must be true* in order to exclude magic from the realm of science.

Division by zero is in fact not even a valid mathematical operation, but rather the description of a *trend*: the magnitude of the quotient is inversely proportional to the magnitude of the divisor. Similarly, all other uses of infinity in mathematics are mere convenient shorthand notation for the identification of trends. For example, a quantity "approaching infinity" is the same as a quantity increasing without bound. At any particular time, it will still be a *finite* quantity.

Why Space and Time are Neither Infinite Nor Finite

Essay LXVIII

Here, we identify and refute further common mistakes regarding the concept of "infinity".

Mistake: If infinite quantities cannot exist, then space itself is finite.

All quantities are attributes of *existents.* Space is *not* an existent. It is a mere positional relation of existents with respect to each other. There cannot simultaneously exist an infinite number of *existents*, but space itself cannot be said to be finite or infinite. As far as space-as-absence is concerned, it cannot be said to *be. Something* – i.e., an existent – *is. Nothing* – i.e., space-as-absence – is *not.*

This is why all coordinate systems must presume an arbitrary origin at some point; there is no “universal fabric” for them to be anchored onto. But, just as an entity can be conceived to exist at (0,0,0), so can it be conceived to exist at (10^{87}, $9*10^{65}$, $2.79*10^{988757}$), which is just a set of numbers describing its relation to an entity that could exist at (0,0,0).

A spaceship with recyclable fuel could be equipped to distance itself from other existents indefinitely. At any time, it will still be a *measurable distance* from those existents, and its distance would be finite. No matter how large this distance is, however, it could always become larger. $2.79*10^{988757}$ +1 is a conceivable number, but *infinity* is not.

Space is neither finite nor infinite, but it can be said to be *indefinite.*

Mistake: If everything is finite, time must have had an origin.

Time, too, is not an *entity.* While space is a relationship in three dimensions, time is a quality that enables the establishment of relationships in the fourth dimension. It can be measured by any uniform standard we deem fit, and something can be chronologically remote to something else in either direction to any finite quantity. Though this quantity must be finite, there is no limit to *how large* this quantity can be. Like space, time is neither finite nor infinite, but rather *indefinite* in two directions (earlier and later).

Here, it is fitting to note that each dimension (and there are only four) describes a particular relationship, and is indefinite in two directions: time (earlier and later), height (up and down), length (front and back), and width (left and right). This is a *philosophical insight* that the specific-observational sciences cannot nullify by *any* amount of theorizing or observation.

Mathematics, being a sister foundational science to philosophy, calls this truth in the three spatial dimensions *Euclidean space.* Perhaps it would be fitting to refer to it in all four dimensions as *Euclidean space/time,* which is based on arbitrarily designated uniform units. Euclidean space/time is to the natural sciences a *metaphysical given* that mathematics must accept as valid if it is to function in this world.

Neither the specific-observational sciences nor mathematics can legitimately claim the existence of more than three spatial dimensions and one chronological dimension. Thus, dimensions with numbers like 6, 2.34, or e+3/4 must be immediately rejected as unreal and logically absurd.

Consistent and rational application of philosophy can indeed tell us many things about the nature of existence: indefinite Euclidean space-time, the impossibility of simultaneous infinities, the possibility of indefinite, but not infinite, measurements of all qualities – including the four dimensions of Euclidean space-time – and the nonexistence of infinite divisibility.

Philosophy can also help alleviate senseless scares about the "inevitable end of everything", which threaten, by no legitimate logical basis, to render the long-term purpose of existence itself meaningless.

Whenever one uses the term "infinity", one treads a thin line (though not an *infinitely* thin one!). I make no apologies for the term's existence, however; like "universe," it can be a convenient intellectual shortcut to lengthier expressions of mathematical and natural trends. It can also be used to point out logical *impossibilities.*

It is convenient, for example to inform an opponent in debate, "You claim the existence of a simultaneous infinity. This means you have committed a logical fallacy." But, in the vast majority of cases, the term "indefiniteness" is far more suitable to describing an entity or phenomenon than "infinity". The latter term suffers from improper cultural use, and has far exceeded its boundaries, ironically enough. It is time to constrain the term "infinity" to its proper limits.

Chapter X
On the Nature and Origins of Life

The Possibility of Life's Origins from Non-Life

Essay LXIX

The unique nature of processes categorized as "life", their intricate complexity, their capacity for self-sustenance and self-generation, often cause many thinkers to interpret their origins as something distinct from the origins of inanimate matter, which can be said to act "deterministically", in accordance with clearly identifiable and predictable laws of physics.

In many qualities, these immense differences between life and non-life hold, especially with regard to life of the highest echelon – i.e., the life of entities of volitional consciousness. However, does the origin of life itself necessitate a similar distinction?

A position is put forth by such thinkers as Mr. Reginald Firehammer that, due to the evident distinctions between life and non-life, the latter could not have ever been in a state of complete monopoly over the sphere of existence or given rise to the former; the quality of life, along with the qualities of volition and consciousness, would need to have existed, according to Mr. Firehammer, for all time eternities back. Given that both I and Mr. Firehammer do not hold time *per se* to have had a chronological origin (such as, for example, a Big Bang), this would mean that the existent "life" is an infinity old.

Whether or not Mr. Firehammer's proposition is valid hinges on a crucial question: "*Can life in fact originate from non-life?*" To answer this question, it would be enlightening to examine a field properly known as the "study of life" (biology) and then apply the results to the study of existence (metaphysics).

For the majority of the 19th and early 20th centuries, it was held that life and non-life were mutually exclusive spheres, and no amount of chemical interaction could transform non-life into life. This belief was termed *vitalism* and was adhered to by the predominant scientific minds of the day. Yet the foundations of vitalism crumbled in 1953, when Stanley Miller of the University of Chicago recreated, in a simple experiment, the atmospheric conditions which would have prevailed on the early Earth. The early atmosphere, made primarily of hydrogen gas, ammonia, methane, and water vapor, was conducive to the spontaneous formation of all twenty known amino acids, the building blocks of proteins and contributors to DNA and RNA genetic codes.

Amino acids are organic compounds that were once thought by the vitalists to be impossible to obtain by reaction of non-organic chemicals. According to post-Miller evolution theorists, natural selection acted on these molecules before life itself came to be. These findings suggest that it is indeed possible for life to arise from non-life.

The vitalist position was completely and obviously invalidated by J. Craig Venter's creation in 2010 of an entirely artificially designed living organism, the *Mycoplasma mycoides.* This synthetic bacterium was designed entirely by humans, without emerging from a previous species.

Of course, vitalism was not viable for a long time, and, for intelligent students of the natural sciences, its patent falsehood was evident since Stanley Miller's famous 1953 experiment. But now the case against vitalism is so obvious that only the most dogmatic, evidence-averse individuals could still adhere to it. *There it is* – a cell that was *not* the offspring of another living organism, but was rather artificially synthesized in its every aspect, much as a building might be constructed by the deliberate arrangement of bricks and beams in accordance with a human-designed blueprint.

I welcome the emergence of artificial life and all of the impressive possibilities that it offers even in the near-term future – from improved and rapidly produced influenza vaccines to microorganisms that can clean up oil spills and synthesize new sources of energy. More important, of course, are the long-term implications of this discovery – which are too vast to be foreseen by any single individual. We humans have an amazing ability to discover and engineer the workings of life, and our own lives should become ever longer and better as a result.

An Evolutionary Explanation for the Origins of Life

Essay LXX

Stanley Miller's 1953 experiment demonstrated the possibility of the spontaneous synthesis of amino acids from inorganic compounds. From this discovery, a logically consistent and empirically verifiable evolutionary origin for life itself has been posited.

Through favorable chemical attractions, the amino acids and miscellaneous substances formed in the early atmosphere became arranged into macromolecules, which later aggregated into protobionts – collections of molecules that possessed the peculiar quality of generating copies of themselves.

Some of these early protobionts were molecules of RNA, which, after hundreds of millions of years, became incorporated as a genetic code within the simplest cells of prokaryotic (bacterial) organisms. Hence, over a colossal amount of time, non-life was able to generate life.

These very prokaryotic forebears of higher-order life forms, however, made it difficult for further spontaneous conversion of simple molecules into organic building blocks to occur. Many of them produced oxygen as a byproduct of their photosynthesis, which altered atmosphere composition and caused it to become an oxidizing atmosphere rather than a reducing one. (Spontaneous reactions are more likely to occur in a reducing atmosphere.)

Once life was already in existence, the barriers between it and non-life became more distinct and less prone to transgression, except by modern technology and the minds of those entities who exhibit the highest of the qualities applicable to living beings.

Some 45,000 years ago, the Cro-Magnon man, *Homo sapiens sapiens*, evolved another peculiar chemical adaptation, volitional consciousness, brought about by a highly expanded cerebral cortex. Just as the structural reorganization of matter facilitated the processes of life, so might an evolutionary tweaking of human ancestors' genomes have brought forth the *capacity* on the part of these early men to *deliberately manipulate the physical and chemical processes within their own organisms*, thus resulting in the directed, autonomous action evident and inherent in humans today.

What may be responsible, as the manifestation of this genetic change, is not a single "central region of volitional consciousness", but rather an *integrated sum*, just as a machine's functionality cannot be reduced to one or two gears or levers, but would be impeded if any gear or lever were hampered.

The evolutionary interpretation of life's origins can escape determinism by claiming the following: W*hile life as a process consists of physical existents entirely, it implies an integrated sum of wholly material existents that is capable of directing itself to whatever degree pertains to the order of life in question.*

Hence, it is not necessary to claim that life had existed in perpetuity, because its complexity is impossible outside the necessary material components that facilitate it. And, while it is certainly possible that similar chemical processes leading to life's formation had occurred at some point in time in another star system, this proposition is, for the moment, unwarranted by any positive evidence. Hence, in the context of our knowledge today, the life which began on Earth some 3.5 billion years ago is the sole representation of life accessible.

The evolutionary approach to the question also avoids the dilemma of an intelligent creator of life. If life's ultimate origins had been spontaneous chemical reactions, we need not be trapped in infinite regress attempting to determine the creator of the creator of the creator and a chain of intelligent super-entities *ad infinitum*.

Chapter XI
The Physicalist View of Life, Consciousness, and Volition

Complex Self-Sustaining Physical Systems

Essay LXXI

The thinker Reginald Firehammer has recently released an installment in his project to create an objective, rational ontology. This treatise, titled "Life", explores Mr. Firehammer's ideas concerning the ontological nature of the process of the same name.

As a purveyor of a different fundamental definition and thus a different theory on life, however, I intend to give Mr. Firehammer's treatise a thorough analysis with the intention of demonstrating where he has erred.

Using Mr. Firehammer's language, I would be called a "physicalist", who holds the view that "whatever is not physical does not really exist, or at least only exists as phenomena of the physical."

To clarify, a physicalist such as myself still considers life, consciousness, volition, ideas, abstractions, and concepts to have a real existence. However, he considers all of these phenomena as arising from certain physical interactions, be they among parts of the body or cells of the brain. He recognizes that any concept must ultimately refer, however indirectly and by whatever multiplicity of steps, to properties of physical existents and be formed by a physical mind in a physical brain. He recognizes that life, perception, and volition are the result of an immensely complex series of physical interactions among the trillions of components of the human organism – a system so complex that it has attained the capacity to direct its own operations in a self-sustaining manner instead of just being passively manipulated from without. There are essential differences between this position and Mr. Firehammer's, and I hope to demonstrate the greater accuracy of the physicalist view in the course of this treatise.

Mr. Firehammer writes:

> *If consciousness were only physical matter as the physicalists maintain, we would not be entities of matter* and *conscious[ness], we would simply be entities of matter. But, we are not only beings of matter and consciousness, but volitional beings, and Ayn Rand makes it very clear, volition is not a physical attribute, that volition is impossible to physical matter alone.*
>
> *"The day when [one] grasps that* matter has no volition *is the day when he grasps that he has – and this is his birth as a human being." ["Galt's Speech", For the New Intellectual, Page 156.]*

What Rand was referring to is *inert* matter (for which the word "matter" is but convenient intellectual shorthand) – i.e., matter that is *(i)* outside the human organism itself and *(ii)* incapable of changing its state unless acted upon. Inert matter behaves as described by Newton's First Law; if it is rest, it will remain at rest until something else moves it. If it is moving at a certain rate, it will keep moving at that rate until something else stops it.

All matter follows Newton's First Law, and it seems on face that this means that all matter is inert. However, we might consider the following system: particle A, in motion, pushes on particle B, which is thus put into motion from a former state of rest. All of A's momentum is transferred to B, and thus A is now at rest. B similarly pushes on C and facilitates its motion while itself coming to rest. The paths on which these particles move are such that C's motion is directed precisely toward A. C transfers its momentum to A, and the cycle repeats itself indefinitely.

A, B, and C are discrete particles of matter that must have other particles act on them, but the *system* of A, B, and C, is entirely self-sustaining in that the action performed by the *system* – i.e., the perpetual motion of the particles – is not caused by any entity outside the system. This scenario runs into several problems, which preclude it from describing what is known as "life". For example, friction and energy loss through heat in the course of the collisions would eventually bring the motion of the particles to a halt, and the particles are unable to actively respond to these external influences.

But what if a system were to exist that was able to *counteract* its own losses of energy? What if, for every joule of energy lost, the system would take in a joule of energy to compensate for it? What if the system was able to actively *seek out* those sources of energy so that it would have a greater chance of experiencing no shortfall of them? What if it was able to, solely through the functioning of its constituent elements, manifest an adequate response to *whatever* external stimulus affected it (unless that stimulus were to grossly disrupt the response mechanisms themselves)?

Certainly, the system thus described would need to be of immense complexity, and no three-particle system would suffice to furnish all of these purposes. Therefore, no system of three particles, or even three million of them, has ever been observed to be alive or to exhibit the above-described reciprocal interactions without eventually succumbing to heat and friction.

However, let us examine a typical human being whose body has about 10^{28} atoms in it, which, for all purposes of macroscopic analysis, can be considered fundamental discrete particles. Might it not be possible for a system of 10^{28} particles to be arranged in such a manner as to facilitate adequate and long-term responses to a multitude of external forces that would attempt to disrupt the system and its processes?

Of course, not every system of 10^{28} particles will necessarily suffice for this purpose, as the *spatial arrangement* of specific particles in the proximity of specific others is essential to the functions such a system would need to undertake in order to be deemed alive. (For example, not every way that A pushes B will guarantee that B will come into contact with C.)

Furthermore, the particles themselves and their specific natures are also crucial in determining the adequacy of the system for sustaining itself. The human body possesses an unparalleled diversity of atoms and molecules in it, many types of which are compartmentalized into particular cells, tissues, and organs so as to be more effectively devoted to the purpose with which they are most commensurate.

A large metal ball, however, though it might even have more particles in it than a human body, is still inert matter, because its constituent elements are not diverse enough to facilitate the complex functions necessary for the metal ball to be able to resist external forces that preclude it from sustaining its activities indefinitely and on its own. But the human living organism is both entirely physical *and* so configured as to be capable of self-direction to an extent that enables it to transcend the designation of mere inert matter.

Emergent Properties as an Explanation for Life, Consciousness, and Volition

Essay LXXII

How, one might ask, is it possible to have constituents which are inert matter add up to a system that is not – i.e., a system that is *alive*? Would that not imply that the whole needs to be greater than the sum of its parts, or any other sort of creation *ex nihilo*?

But this is not at all the case. One of the parts that constitutes the whole in a living system is the sum of the *spatial relationships* among the various cells, tissues, and organs of the body.

By themselves, the cells, tissues, and organs are indeed inert in most cases, as they do not exhibit the necessary spatial and motional relationships to other cells, tissues, and organs. When they do exhibit such relationships, however, another factor has been added into the equation, which makes the sum of its parts precisely equal to the sum of its parts – i.e., a living system.

Furthermore, might it not be possible to have a system that is not only capable of reacting to external stimuli in a self-perpetuating manner, but also acting in a certain manner at a certain time *when it is physically possible for another course of action to happen at that time*? That is, might it be possible for the system to *deliberately* behave in a certain manner, and to *know* that it is deliberately behaving in this manner, and that it is thus behaving not because of any external compulsion, but because of the system's own self-induced workings?

Here, we have described a system that has both consciousness and volition – a system that is aware of its own existence and environment, and capable of *choosing* what to do with it. This system is a far cry from the discrete particles of inert matter that have no volition of their own, even though not a single particle within the system itself has any more volition than it would have had outside the system.

Rather, what possesses volition is the *sum* of the particles, or the system itself. Qualities a system possesses that its constituents, in severance from one another, would not, are called *emergent properties* in biology, and are at the core of the biological hierarchy of existence. Without emergent properties, tissues could not be more complicated than cells, organs could not be more complicated than tissues, and organisms could not be more complicated than organs. Since we know the contrary to be true, we know that emergent properties must exist.

The highest emergent properties possible are life, consciousness, and volition, in ascending order. The reason that emergent properties can exist has already been stated as being the *spatial synthesis* of hitherto separate inert or less complex constituent parts.

Ayn Rand was correct to make a distinction between a mere chunk of inert matter and the most complex system of all, the human organism. Surely, the former has no volition, but the latter does, and the latter does *precisely because of* emergent properties as described by the physicalist view.

The Rejection of the Cartesian Dualist Position Regarding the Human Mind

Essay LXXIII

The traditional Cartesian dualist argument, stemming from the ideas of Rene Descartes (1596-1650), asserts that the mind itself is not physical, although it is capable of perceiving the physical world. This essay shall endeavor to refute this view and its current manifestation in the ideas of Mr. Reginald Firehammer.

In his essay "Life", Mr. Firehammer continues to make his argument on the separation of matter and consciousness:

> *"Even if Ayn Rand had never specifically said the physical and consciousness were not the same thing, it is not logically possible that they be. Physical existence is that which consciousness is conscious of. That which consciousness is conscious of and the consciousness itself cannot be the same thing; if they were the same thing, that is if the consciousness itself were the physical, it would be conscious of itself, which leads either to extreme empiricism (essentially denying that consciousness exists) or idealism (essentially denying the physical exists, that is, solipsism). Existence and our consciousness of it cannot be the same thing, consciousness cannot be physical."*

This argument is remarkably similar to Cartesian dualism – the idea that, by virtue of the mind being aware of the realm of physical existence, it must be outside that realm entirely. Yet this argument falls into the same trap as the following line of reasoning, in the case where a rolling ball is pushing a box: "That which the ball is pushing and the ball itself cannot be the same thing; if they were the same thing, that is, if the ball itself were physical, it would be pushing itself, which leads you to either deny the ball or the physical..."

Yet we know very well that both the ball and what it is pushing are physical. It is true that the ball and that which it is pushing are two different things. But nothing precludes them from having a similar *attribute* of being physical!

Similarly, nothing precludes something red from pushing something else that is red, or something big from pushing something else that is big. While it is true that what consciousness perceives is not consciousness itself, and that what it perceives is physical, never in those facts is it implied that consciousness itself cannot be physical.

Consciousness is a physical process that perceives other physical things outside itself. Since "the physical" is not one giant entity, but rather an attribute that trillions of *distinct and discrete* entities share, it is quite possible to perceive something physical while still being physical and not being a part of the entity one is perceiving.

In his argument above, Mr. Firehammer has committed the fallacy of reification, which he defines as "Treating abstractions as actual existing entities or regarding them as causally

efficacious and ontologically prior and superior to their referents." (The Autonomist Logic Fallacies). He is treating the word "physical" as an entity in itself, ontologically prior to the discrete entities which all have the attribute of being physical but are all separate from one another nonetheless.

Life as a Purely Physical Process

Essay LXXIV

In his essay "Life", Mr. Reginald Firehammer tries the following approach to disprove the physicalist worldview regarding life, consciousness, and volition:

> *"The mistake made by those who are physicalists for that reason is the assumption that if we cannot be directly conscious of a thing, it cannot be. The danger of this mistake is that it leaves the door open to mysticism, because it is obvious to everyone that there are phenomena which we cannot directly perceive, but know, if no other way, at least from introspection*."

The issue here is to whom the pronoun "we" refers. If "we" means any given single individual, then there are indeed things that that individual cannot be conscious of, such as the entirety of another person's life, consciousness, and direct experiences.

However, if "we" means all of the human beings who exist and have existed, then no such experience has ever been inherently barred from being fathomed by the *sum* of those people's knowledge. Person A is aware of his own consciousness, Person B is aware of his own consciousness, and each of them can harness this knowledge in useful ways.

The physicalist view does not state that *anybody* can directly perceive *everything* (even the time limitations on this alone make this impossible), but rather that for *anything that exists*, there is the potential for *somebody* to perceive it directly.

I would challenge the opponents of this view to name anything that they consider exclusive of such a description, and I will be happy to demonstrate how it, in fact, fits within the realm of perceptibility by *somebody* quite well.

Furthermore, Mr. Firehammer actually concedes the physicalist point in a correct statement of his, as I will endeavor to show by logical extrapolation therefrom:

> *"An organism is not just a piece of complex matter with a process running on or in it. An organism is an integration of physical substance and a process that maintains it as an organism. All that an organism does, as an organism, it does because it is living. The life process, as a process of the organism, is a purely physical process, obeying all the laws of physics, and requires the physical organism to function. One of the requirements of the life process (determined by its nature) is it must maintain the integrity of the physical organism it is the life of*."

If the life process is a *purely physical process*, then life must be purely physical! The very phrase, "Life is a physical process" implies two things: *(i)* the concept "life" is a subcategory of the concept "process", and *(ii)* the concept "life" possesses the attribute "physical". Just as inevitable would be the conclusion drawn from the phrase, "Spike is a black dog," that Spike possesses the attribute "black".

Furthermore, some of Mr. Firehammer's other accurate observations are fully reconcilable with the physicalist worldview, given a certain clarification of terms:

> *"Life does not exist independently of the organism, but it is the life, the self-generated and self-sustained process that creates (grows) and sustains the organisms as a living entity. An organism is not just a physical entity that behaves in an unusual way. An organism is a unique kind of existent. An organism not only ceases to be an organism if the life process ceases, it begins immediately to change physically in response to the physical laws that govern the behavior of the merely physical."*

This is another way of stating that an organism possesses a level of organization capable of resisting the external forces that would cause the organism to break down. Once this level of organization is somehow disrupted or destroyed, what was formerly the organism now becomes inert matter and is capable of being affected by those destructive forces without exhibiting an appropriate response to them.

Why this fact precludes the organism from being "just a physical entity", however, is not proved by Mr. Firehammer. His definition of the "physical" seems to encompass only the outside processes that work to impose themselves on the organism, and not the processes of the organism that work to counter this imposition and thus maintain the organism. Yet this same distinction is contradicted by Mr. Firehammer's own admission that life is a "purely physical process".

How Life Follows the Laws of Physics

Essay LXXV

Mr. Reginald Firehammer, in his essay "Life", presents further arguments against the physical nature of life. But these arguments do not demonstrate his intended point. This essay shall give responses to Mr. Firehammer's claims and demonstrate how it is possible for life to follow the laws of physics.

Mr. Firehammer writes:

> *"It is not a 'system' that is alive. You may think of an organism is a 'system,' but if it is only the physical system, it is not alive itself. What is self-sustained is the process which uses the physical aspects of the 'system' (organism) to sustain itself and the organism as an organism. It requires those physical aspects because a process must be a process of something. In that sense, it also maintains the organism as a living entity. As soon as the process ceases, the physical entity is no longer an organism*."

A "process of physical entities" is a relationship among those physical entities whereby, in their spatial, motional, or other interactions, the entities affect one another's qualities. That is *all* any process is; it is the sum of the entities that partake in it and the attributes and natures that those entities exhibit.

To say that life requires physical entities to be "a process of something" is to concede that the only things life is a process of are physical things, and that life is therefore wholly physical, since a process cannot be defined outside the things it is a process of.

Mr. Firehammer further tries to exclude life from the laws of physical causality:

> *"I have never said the life process is not subject to the laws of causality, but that it is not subject to physical causality. Cause is determined by the nature of the entity or existent doing the acting.* Life does not have mass, a pH factor, a temperature, an electromagnetic state, or any other physical property or characteristic. *Since the nature of life and the nature of the physical aspects of the organism share no qualities or properties their natures are entirely different and the specific causes that determine their behavior are entirely different."*

It is true that life does not have the measurements Mr. Firehammer described, just as motion does not have mass, or sound waves do not have temperature. Mass and temperature are qualities of entities, not relationships (or processes, which are types of relationships). Life, being a relationship, has different qualities associated with it, which are qualities defined in terms of how the relationship *affects* the entities partaking in it.

But this does not mean that life does not follow the laws of physics, especially since all the entities that partake in the process known as life are physical and follow said laws. Mr. Firehammer's mistake is in thinking that the laws of physics are somehow deterministic with regard to *all matter*.

However, the laws of physics, even in their very formulation, have always been conditional. To paraphrase Isaac Newton, *if* an object is at rest it will remain at rest unless acted on by an outside force. *If* a force is acting on an object, it will be equal to the product of its mass and acceleration. *If* an object is pushed by another object with a certain force, it will exhibit an equal and opposite reaction force on that object. All the laws of physics, properly rephrased, entail an "*if*" component to them, which renders them conditional on the given situation and raises the question: what *brings about* the situations wherein these laws can manifest themselves?

It is true that the situation can be brought about by inert matter acting in certain ways in accord to its nature (such as a rock pushing on another rock), but it can just as easily be brought about by a complex system that *deliberately seeks* to exert forces on inert matter. This system has become so complex that it is capable of exerting forces both on entities external to itself (such as rocks) and internal to itself (such as its own limbs or its own mind).

The life process not only follows the laws of physics; it is *essential* to bringing about the conditionality requirements for its own components to fulfill the laws of physics in a certain

manner. The life process is brought about by physical laws governing its constituent entities, and then becomes complex to the point of *governing the conditions* in which its constituent entities will be put so that those specific physical laws will apply to those entities as are appropriate for the survival of the organism.

The Consistency of Life's Continuity with Its Physical Nature

Essay LXXVI

Some opponents of the physicalist view of life claim that because life is a continuous process, but the physical parts of the living organism change on a regular basis, it follows that life itself cannot be physical.

Yet, as we shall examine here, life's continuity is in fact entirely consistent with its physical nature, because a living organism is a physical *system* in which multiple fungible parts can perform the same function – being successively replaced without disrupting the system's functionality.

In his essay "Life", Mr. Reginald Firehammer further tries to bring up "evidence" as to the non-physical nature of life, volition, and consciousness:

> "Continuity – *whether it is life or consciousness, an organism has the same one moment to moment, day to day, and year to year. It is the same life and the same consciousness from the moment it becomes conscious until it dies. It is because consciousness and life are not physical this is true. Notice, the physical characteristics of an organism can change. Hypothetically, all of the physical parts could be changed, but it would still be the same organism, because it would still be the same life process and the same consciousness. It is the life process that is the independent existence that identifies the organism as a particular organism, not the physical components, and consciousness is an attribute of life.*"

This is true because what is alive, conscious, and volitional is the *system* and not any one component. So long as one entity in the system is replaced by another fungible entity (i.e., one capable of performing the same functions and exhibiting the fundamentally same nature as the entity it replaces), the same system continues to function.

But this is very much in line with a physicalist interpretation. Similarly, one can replace a gear in a clock and still have it remain the same clock; one can, over time, replace each single original part of the clock, yet still retain the same process functioning in the clock – i.e., the capacity to tell time using a certain mechanism.

Living organisms are much more complex than clocks and are capable of replacing most of their worn-out or damaged components *without significant impairments* to their functionality. Thus, they indeed have a greater degree of continuity than less complex systems, but this is a difference of degree only and not indicative of any claim that life is not a physical process.

The Consistency of Life's Unity and Subjective Perception with Its Physical Nature

Essay LXXVII

In his essay "Life", Mr. Reginald Firehammer claims that the unity of life and consciousness precludes them from being physical:

> "Unity – *this aspect also pertains to both consciousness and life, but is more apparent as a characteristic of consciousness. Any organism has only one consciousness and it is the same consciousness that perceives what is seen, what is tasted, what is heard, smelled, and felt. It is the same consciousness that feels the wheel of the car with the hands, the accelerator pedal with the foot, sees the light change from red to green, and hears the music on the radio all simultaneously. This aspect of consciousness is almost never recognized. It is one reason, for example, no computer or computer program will ever create consciousness. It would be impossible, at the physical level, to make all the discrete physical events required for detection of separate phenomena be a single event. Because consciousness is an aspect of life, however, which is not physical and not limited by physical attributes, such as discreteness, the same consciousness can be conscious of an indefinite number of things at the same time.*"

But Mr. Firehammer is mistaken here. What consciousness perceives *is* in fact a series of discrete physical entities and events! The fact that consciousness perceives them accurately by noting that they are simultaneous is no repudiation of its physical nature.

It is quite possible for a physical system to run multiple simultaneous processes in unison, for the creation of a single effect or result which integrates the work of all those processes. (Consider even a car wash, where the car is subject to multiple treatments at the same time – all, however, working toward a single result: the cleanliness of the car.)

Man's simultaneous awareness of multiple processes and external stimuli is a testament to the extraordinary complexity of his sensory organs and consciousness, but it does not refute the physical nature of his perception. After all, he continues to perceive all the different external entities and processes as *distinct.* They do not blend into a single sensation for him. He is always clearly able to distinguish taste from touch and a sound from a view; moreover, he can distinguish multiple entities or processes perceived through the same sense from one another.

Mr. Firehammer further writes:

> "Subjectiveness – *consciousness in all other creatures except ourselves is inferred, because consciousness is a subjective experience. There is no doubt that this inference is correct, but consciousness, itself, cannot be directly perceived, even in other people, much less other animals.*"

This is true in the sense that nobody can experience what another conscious entity experiences at the exact same time that it experiences it, without being that entity. However, as subsequent essays will show, it is indeed possible to know what another's consciousness is *like* and to objectively verify the validity of certain experiences.

Nothing, moreover, bars subjectiveness from being an emergent property as I had earlier described. The fact that a system is capable of directing itself, but in a way that no other external force is capable of directing it, means that the system must have some special and exclusive level of access to its own workings that no external entity or system can have. Subjectiveness is the manifestation of such a level of access, and may well logically follow from the fact that a spatially integrated system has a far greater ability to control its own functions than another system spatially remote from it.

The Importance of the Physicalist Worldview to Human Progress

Essay LXXVIII

There is an essential twofold implication in the physicalist worldview that necessitates its defense as a means of understanding and improving the future of human progress.

First, the physicalist worldview affirms the possibility of *creating life out of non-life*, given a sufficient degree of systematic complexity. Second, it supports the *improvement of life processes using the laws of physics.*

This is the only view of life, consciousness, and volition fully compatible with the idea that technological progress has no inherent limits which it cannot overcome, that progress will eventually bring about any capacity that human beings can conceive of.

The physicalist worldview supports the possibility that it might someday be possible to create electronic improvements upon human consciousness and thus expand the processing capacity of the human mind. It considers feasible the eventual integration of inert matter not originally in the body in order to enhance the body's functions and render it less susceptible to external perils (through the use of disciplines such as nanotechnology). The physicalist even sees in the future the ability to extend human volition over presently involuntary body processes so as to direct them more efficiently.

Above all, the physicalist believes that the present forms of life, consciousness, and volition as manifested in human beings, though they are the highest and most advanced that ever existed, are not the highest and most advanced that *could possibly exist.* There is no such "ultimate limit," according to the physicalist.

Since the only way in which human beings can create technology is by manipulating physical entities, by acknowledging that life is physical, the physicalist admits the possibility of improving upon life by manipulating physical elements.

This is the only view that rids man of the tragic fatalism which would state that, no matter how sophisticated or advanced his life, consciousness, and volition are, he is doomed to perish, because even his most complex attributes are still extremely vulnerable, and nothing can be done to improve them.

The physicalist recognizes that no system is doomed to end unless it ceases to resist the destructive external forces that endeavor to break it apart. His is the endeavor of gathering what knowledge and resources he can, in order to resist those forces indefinitely and to the best of his capacity.

Indeed, with the emergence of genetic engineering, we have seen how greatly *other* living organisms can be improved from human benefit through physical manipulations. Our food supply has been quadrupled as a result of genetically enhanced crops, and it will soon be possible for genetically enhanced animals to provide us with safer, healthier, and more nutritious meat, milk, and other products. These accomplishments are empirical testaments to the accuracy of the physicalist worldview, and the forthcoming endeavors to rid *man himself* of perilous diseases and crippling defects will further confirm it.

Chapter XII
The Objectivity of Consciousness

Can We Observe Others' Consciousness?

Essay LXXIX

Partly as a response to my essays on the physicalist view of life, consciousness, and volition, Reginald Firehammer has published the treatise "Consciousness Itself", in which he presents, among other ideas, his rebuttal to the physicalist model of consciousness.

Within his arguments, Mr. Firehammer posits the notion that consciousness is inherently subjective and that no man could possibly know what another's consciousness is like. As I am an adherent of the physicalist view, I see fit in this essay to explicate my true position on consciousness.

I shall defend the proposition that consciousness, like all other aspects of reality, is *objective,* meaning that any individual, if he undertakes the required procedures, *can* understand what another's consciousness is like.

According to Mr. Firehammer, there is an inherent limit to what we may know about another's consciousness. He writes:

> *"Consciousness in other people and other creatures is inferred from their testimony (in the case of people) or their behavior (in the case of animals), but cannot be directly*

> *observed. We believe the testimony of others about their consciousness, because what they describe sounds exactly like what we experience, and we have no reason to suspect them of deceiving us. If someone were not conscious, it is unlikely they would attempt to fool others into thinking they were. If they were not conscious, how would they know what it is and what possible motive could they have for deceiving others about it*?"

Mr. Firehammer claims that it is impossible for us to definitively *prove* that somebody else is conscious, and, where the capacity for proof is absent, we have to simply take their word for it. Or, in the case of animals, we see that their behavior is sufficiently interactive with their environment to presume that they possess consciousness.

Yet, this argument runs into a pitfall. Even using today's computer technology, it is possible to create a "talking program" with a sufficiently broad ability to respond to a variety of data input. It might even be possible to program the computer to state, "I am conscious," as an answer to the corresponding question.

Yet, it is also known that a contemporary computer is not conscious, no matter how interactive it might be – though we cannot rule out the possibility of future, more advanced machines developing an emergent property of consciousness. If the computer is not conscious, and the animal is, there must be a means of demonstrating both truths. Clearly, then, to delineate between what is conscious and what is not, especially in so-called "borderline cases", we need a more rigorous standard of proof.

Yet, under Mr. Firehammer's model, this standard of proof is nearly impossible to establish, as Mr. Firehammer denies almost *any* certainty of similarity between even the perceptions of two human beings:

> *"In general we assume another's consciousness is like our own, and there is good reason to assume it. In fact, however, another's consciousness could be quite different, and we could never know it. If we try to explain to one another what our consciousness is like, I may give you examples of how I perceive things, and you the same. For example, I might point to a red car and say, "I perceive that color as red," and you might point to a blue car and say, "I perceive that color as blue." Neither of us will be astonished that we agree on the names of the colors, but, if we think we have any more idea of how the other actually perceives those colors, we are mistaken. The actual conscious experience I have when seeing red might be the actual conscious experience you have when seeing blue, and the actual conscious experience you have when seeing red might be the actual conscious experience I have when seeing green."*

So, Mr. Firehammer's model leads us to a dead end in terms of demonstrating objectively the existence of consciousness. The ostensive demonstration that he likes to employ is, in many cases, inconclusive. Even for some human beings, it is at times hard to say whether they are conscious! Anyone who has observed a zombie mesmerized by “gangsta rap” would express a similar doubt.

And, to add to the problem, Mr. Firehammer claims that there is no other gateway to an understanding of consciousness that we can employ, since, in his theory, he has placed barriers between even elementary perceptions of various individuals. To demonstrate the existence of consciousness objectively, we must show that these barriers are artificial and remove them.

Perceptual Similarity among Healthy Individuals

Essay LXXX

Here, I will demonstrate that human perception of physical phenomena is, for all healthy, non-handicapped persons, fundamentally the same and provides accurate knowledge about the natures of said phenomena.

My contention is as follows: Let us presume that you and I are entirely healthy individuals, with no sensory impairments. If I observe a red ball (or any other entity) from a given angle, and then you observe the red ball from the same angle, in the same environment, we will both see the same red ball in the same way. There will be no difference between my perception and yours. To demonstrate this, only the physicalist model of consciousness will suffice.

The physicalist model acknowledges that there are physical mechanisms which are necessary for consciousness to function. The eyes function as receptors of light of a certain "frequency", which then transmit a signal of the light's reception through the optic nerve to the visual cortex of the brain.

For all healthy organisms in the human species, even though they will vary somewhat in their genetic makeup, the *functionality* of all their organs will be the same, and so will be the *mechanisms* by which these organs will function. For two healthy human beings, the eyes may be of different colors, shapes, and sizes, but their functional structures will all be the same.

Similarly, two healthy individuals may have brains of different sizes, but the innate qualities of their brains would be identical, including those qualities which *automatically* (i.e., non-volitionally) allow a human being to experience perception of the world around him.

It is true that two healthy individuals may differ vastly in intelligence, reasoning, and speed of thought. However, none of this is due to any inherent difference in the perceptual mechanisms of the brain. Every man is born *tabula rasa*, meaning that every man's *intellectual* mind is a blank slate, but every man's *perceptual* mind is already fully established at birth. Provided that one's organism does not suffer any physical impairments, the way one perceives with one's senses never changes during one's life.

Physics has already demonstrated that variety in colors is a result of quantitative differences in the measurements of light on the electromagnetic spectrum. (This model is contingent on experiment, and there can be legitimate disputes about what the true units of measurement pertaining to the electromagnetic spectrum are. However, one thing is certain: there is a way to *quantitatively measure* differences in color.)

Thus, if you and I have the same functional structures of the eyes, and the same perceptual capacities of the brain, we will "see" the same thing when the same "frequency" of light enters our pupils at the same angle in the same environment.

It is true that I can never have your *particular experience*, in the sense that I cannot *be* you. However, I *can* fully know what that experience is *like*, by looking at the same object, in the same environment, from the same vantage point as you did. Auditory, olfactory, and tactile senses have similarly been explained in terms of quantitative phenomena (be they sound waves, chemical interactions, or variations in temperature and pressure), and, given a certain quantity of external stimuli, coupled with fundamentally same physical mechanisms (ears, nose, hands, brain) in healthy individuals, will produce the same perception in multiple people.

The Possibility of Knowing Other Organisms' Consciousness

Essay LXXXI

We have already demonstrated the essential similarity of sensory perception among all healthy human beings. But this is not the extent of consciousness's objectivity; it is even possible for healthy human beings to obtain accurate knowledge of the conscious states of handicapped humans or animals with different perceptual mechanisms.

The similarity of human perception holds not only for specific entities, but for perceptual qualities in general. The color red, associated with a certain "wavelength" of light, will always be perceived in the same manner by physically healthy individuals.

Two individuals might disagree about whether a given level of sound is "loud" or "soft", but they will still be perceiving the same level of sound. The difference for them arises from their *subjective interpretations* of the sound they perceive, but the perception of the sound itself is objective and incapable of being "interpreted" by the brain as anything other than what it is.

If the physical mechanisms of perception differ, however, so does the perception itself. For example, a visually impaired individual will see all entities in a different manner than a visually healthy one. A fly with thousands of visual receptacles will see entities differently than a human being with two eyes.

This does not mean, however, that it is impossible for a healthy human being to understand exactly what these modes of perception are *like*. It suffices to know what physical mechanisms of the perceiving organisms are involved in receiving what sensory stimuli. Then, on the basis of this data, a computer might be used to replicate precisely the image that the organism perceives.

Granted, this is not an easy task, and would require an intimate knowledge of another organism's physiology, brain structure, and nervous system, as well as considerable computer processing ability.

Yet such an understanding is quite conceivable, much as it is possible for a computer to currently create an image from the vantage point of a mechanical probe used to explore areas directly inaccessible to human beings. Such probes have already explored shafts in Egyptian pyramids, the depths of volcanoes, and even the internal structures of human organisms, giving man vantage points that he could not have possibly obtained through his immediate experience.

Human beings cannot directly see inside their own bodies, volcanoes, or narrow shafts in Egyptian pyramids, but probes and computers have made it possible for us to understand what such an experience would be *like*. Therefore, contrary to what is asserted by opponents of the idea that consciousness is objective, it is indeed quite possible not only to know what another healthy *person's* consciousness is like, but to know what *any consciousness different from our own* is like.

From the physicalist viewpoint, all consciousness is objective, in that it is a result of objectively occurring physical processes that, if understood, could lead to a full knowledge of consciousness.

The Objectivity of Pain and the Nature of Perception

Essay LXXXII

This essay shall demonstrate the objectivity of the sensation of pain as well as provide a commonsense view of the process of perception in terms of what does the perceiving and what is being perceived.

The Objectivity of Pain

In his essay "Consciousness Itself", Reginald Firehammer tries to demonstrate the subjectivity of consciousness by using pain as an example:

> *"A broken bone is, to consciousness, extremely painful, but a broken bone, as a physical phenomenon, in terms of physics, has no attribute which can be called pain. No x-ray, physical examination, or analysis of any kind will find any attribute about a broken bone which can be called pain. The pain associated with a broken bone exists only in the context of a living organism and only to consciousness. Pain exists and is real, it is an indication of a real physical state, but does not itself exist physically, and has no physical attributes or explanation."*

This is not a correct explanation of pain, as it leaves out the context in which it occurs. Pain is the result of nerve signals being sent into the brain to alert it of physical threats to the organism's integrity. People whose nerve endings in a given area are damaged will not experience pain in that area, no matter how severely they might be hurt.

It is true that analyzing the broken bone in isolation from everything else will yield no clues as to what causes the pain. However, analyzing the *sum* of the broken bone *and* the nerve endings

which connect to it will result in pinpointing the origin of the pain as existing in those nerve endings.

It is also true that the same nerve ending damaged in the same way in two different, otherwise healthy individuals will result in the same amount of pain, perceived in the same manner. But, in essence, there is nothing non-physical about the experience of pain, and, thus, this example does not refute the objectivity of consciousness, nor its existence as a physical process.

A False Dichotomy

Further, Mr. Firehammer seeks to establish a dichotomy between the mechanisms of conscious perception and the perception itself:

> *"It has been suggested that given sufficient complexity in the proper configuration, it is possible for a physical process to produce 'consciousness.' It is supposed, for example, that a complex nervous system like that of the higher animals and human beings in some way produces consciousness. Conscious vision, for example, in this view, is produced by the nervous system providing information from the eyes that are processed in some way by the brain, which process is "seeing." In fact, no physical process can be vision – even if in some way information reaching the brain from the eye through the optic nerves could be processed into an image, it would be like an image on a TV – but an image on a TV is not vision and can only be consciously seen if someone is watching the TV. That is what consciousness is; it is the "seeing" of the image. Whatever the physical brain does, it cannot itself be consciousness. The behavior of the brain is only more physical action; it only makes available to consciousness what is seen, heard, felt, smelled and tasted -- the brain itself cannot see, hear, feel, smell or taste anything."*

This dichotomy, however, is a false one, as it incorrectly categorizes the perception and the perceiver. The perception is not the image formed in the brain, but rather the objective external stimuli that *cause* the formation of the image. The perceiver is not some non-physical process, but rather the *sum* of the mechanisms and processes involved in the reception of the stimulus.

In visual perception, the "image" is the external world. The eyes, optic nerve, and brain are the "seer" of the "image". Whatever "that which is seen" must be, it – like the television image Mr. Firehammer mentioned – must be outside *all* the mechanisms which are doing the seeing.

Thus, the distinction between the seer and the seen *already exists*, and in an extremely commonsense manner, too. There is no need to create *another* artificial distinction by designating that which is seen to include the processing done by the eyes and brain, and then designating "consciousness" in the non-physical sense as the seer. I claim that consciousness *is* the seer, while remaining the sum of all the mechanisms which see, as well as all other perceptual mechanisms in general. The operations of the eyes and brain *are* the "seeing"!

The Simultaneity of Conscious Processes

Essay LXXXIII

In his essay "Consciousness Itself", Mr. Reginald Firehammer claims that consciousness cannot be physical because all of its processes are unified:

> *"In the more formal description of this aspect of consciousness I said, 'It would be impossible, at the physical level, to make all the discrete physical events required for detection of separate phenomena be a single event.' What that means, is, there is no physical system which is able to detect sounds (microphones, for example) images (a video camera, for example), pressure and weight (a transponder system, for example) temperature (and electronic thermometer for example), movement (a electro-gyroscope for example) which can all be recognized in all its detail all this data as a single event or process. The information that all these detection systems provide, at the physical level, must forever remain discrete. The laws of physics and information theory, both determined by the principles that govern physical existence, exclude the possibility that this information can be integrated into a single thing or phenomenon, like my consciousness. If my consciousness were a phenomenon of the physical, it would not be a single thing, but a collection of separate and discrete things. Physically, the unity of consciousness is an impossibility."*

The so-called "unity" of consciousness is, however, in fact, a *simultaneity,* in the sense that the human organism does not have a single location which processes *all* sensory data, thoughts, and emotions. Rather, these occur *alongside one another and at the same time.* The eyes and one portion of the brain account for seeing; the ears and another portion account for hearing; a third portion of the brain accounts for abstract reasoning.

Consciousness is the *sum* of all these processes, which are naturally perceived as occurring at the same time, because they *do.* There is, furthermore, interaction among these various components of the brain, since the simultaneous conscious experiences are part of a single organism. For example, my reasoning faculty can identify the fact that I am seeing and hearing something and analyze that thing. Thus, consciousness amounts to discrete, simultaneous processes unified by highly elaborate interactions among the various functions which make the processes possible.

This idea avoids the accusation made by Mr. Firehammer that the physicalist view would only be consistent with a single "master consciousness cell" that somehow unifies conscious perception. In fact, this does not follow from the physicalist view at all.

The physicalist recognizes that decentralized systems often function far better than centralized ones. Just as an economy governed by the capacities of a single "master planner" would fail, as the contents of that planner's mind are not enough to govern the complexity of interactions within that economy, so would a consciousness guided by the capacities of a single "master cell" never be practical, as that cell's machinery is far from sufficient in directing the complexity of the entire organism.

Rather, the human organism and its consciousness are more analogous to a free-market economy, in which every cell, tissue, and organ performs functions that are most compatible with its nature, and, in turn, result in a stable, efficient, prospering *system* which is the organism and its conscious faculty.

In the "economy" of the organism, additionally, communications among various parts are so well coordinated (just as free markets tend to result in far superior communications compared to centrally planned societies) that, in most cases, the organism acts in unison and is therefore said to have a single identity and individuality. When these communications are disrupted for any reason, the organism begins to act in a way opposed to its survival interests, and is termed diseased or impaired in some manner.

Why Physicalism is Not Mysticism

Essay LXXXIV

In his essay "Consciousness Itself", Mr. Reginald Firehammer levels an accusation against the physicalist worldview that, as paradoxical as this might seem, equates it to mysticism:

> *"The physicalist argument that the conscious experience is an 'attribute' that just 'emerges' from physical events ignores the most important question of all, 'how?' If they answer at all, it is the same as all mystic's answer, 'somehow!' They do not know how it happens, but are sure it does. It is really an odd kind of faith and is based on a kind of paranoid fear of admitting that reality might have attributes other than those of the merely physical. It falsely equates 'objectivity' and 'physics,' as though anything physics cannot explain cannot be objectively true. It is the same mistake the Pythagoreans made in claiming the same kind of universal power of explanation for mathematics (until they discovered incommensurables which drove some of them to suicide.) It is itself a kind of mysticism – a stubborn insistence that no evidence will be allowed that does not fit the physicalist dogma. Once accepted, it apparently makes one blind to the nature of their own consciousness (which is the only one they can know).*"

What Mr. Firehammer fails to realize, however, is the division of labor between the philosopher and the specific-observational scientist. The physicalist is the philosopher. His job is not to show *how* a given system can be explained in terms of physical phenomena, but only that it *can* be explained in such terms. Then, it is the job of the physicist, chemist, and biologist – i.e., the specific-observational scientists – to discover the precise mechanisms, knowing, from the philosopher's reasoning, that they can and do exist.

The philosopher's job is to state what is *conceivable* in a scientific explanation – that is, what is not logically absurd or metaphysically impossible. But no philosopher can, from philosophy alone, advocate a *single specific* model for a given phenomenon. It is the job of empirical investigation to figure out precisely *what* mechanisms are involved in life, consciousness, and volition. This is a vast task, far from being complete.

Just as there are many possible physical models for functional powered flight, so there are many possible physical models for life, consciousness, and volition, and it is the job of the specific-observational sciences, through observation and experimentation, to discover which *one* of these models truly explains how human life, consciousness, and volition function. The physicalist is not omniscient, and he admits it. Yet admitting lack of omniscience is not mysticism; it is intellectual honesty.

Furthermore, physicalism does not rule out laws, abstractions, and models outside the sphere of the discipline of physics. Quite the contrary, it would be rather awkward not to have the laws of economics to explain human action, and try to explicate the latter solely on a subatomic level.

However, the physicalist realizes that all laws, models, and abstractions are ultimately tools that real, physical human beings must use to apply to and interpret the real, physical behaviors of real, physical entities. There is nothing mystical or obstinate about this, nothing stubborn except a categorical adherence to that which exists and a similarly staunch refusal to fall prey to Cartesian dichotomies between mind and matter which neglect the fact that all entities exist in one world, not two.

Chapter XIII
The Implications of Rational Cosmology

Toward a Return to the Enlightenment Views of Science

Essay LXXXV

My aim in *A Rational Cosmology* has not been to reject the *entirety* of today's science or its applications; I am asking, not for a complete discarding of every idea and every tool devised using twentieth-century post-Classical physics, but for a fundamental shift in the theories and concepts governing contemporary specific-observational sciences.

I do not contest that certain systems derived from post-Classical physics work; I do, however, assert that they work imperfectly, and the reason for this flaw is a pervasive conceptual error.

Contemporary science can continue on from its present state in keeping those aspects of it that truly function, while progressively weeding out fallacious notions and replacing them with true ones, thereby gradually refining an imperfect system.

Empirical science ought to be a self-correcting process, contemporary scientists like to claim. I agree. But it is not a process that exists in a vacuum, detached from the rest of human knowledge, especially knowledge so fundamental as philosophy. The only way science can be truly self-correcting is if it applies the proper methodology to the proper existents.

Where it is indeed warranted, science should rely on empirical observation contingent on future particular experiments. In other crucial categories, however, only abstract, deductive reasoning supported by ubiquitous, non-contingent observation will suffice.

What I seek to illustrate here is the type of world we have had – and can still have – when philosophy and the specific-observational sciences worked side by side in a mutually reinforcing, self-correcting process, and the type of world we have gotten by rejecting the very premise of such knowledge integration.

I have, in this treatise, explicated a worldview, elements of which have been implicit in the Western culture that, over centuries of development and refinement, has given birth to the profoundest values and highest quality of life man has ever attained.

While by no means complete or free of errors which were later exploited for their vulnerabilities, Western thought reached its aspirational climax during the 18th century Enlightenment, with its emphasis on the faculty of Reason, and the ability of Reason to fathom every aspect of existence.

Correspondingly, the Enlightenment thinkers and their allies, the Newtonian physicists, viewed reality as having a nature that Reason could fathom. The absolutism of existence – a this-worldly, definite, orderly, material existence – composed of finely delimited entities with particular natures, was a near-universally accepted proposition among the Enlightenment thinkers.

From this stemmed the rest: the objectivity of the human mind and its rational faculty, the necessity of individual liberty to preserve the ability of Reason to fathom all aspects of existence, the increasing recognition of the necessity of technical, esthetic, intellectual, and political progress as the vehicles for expanding man's control over the absolute reality. What followed in the subsequent 19th century, animated by the 18th, was the most massive surge ever experienced in standards of living, public and private morals, the arts and sciences, commerce, and peaceful human cooperation on a worldwide scale.

Positivism's Revolt against Reason and the Enlightenment

Essay LXXXVI

Today, the 18th-century Enlightenment rational and scientific mindset is under attack from all sides, and on all sides the fundamental culprit is the rejection of the objective, fathomable nature of reality.

Technology, the lifeblood and essential mechanism of civilization, is being stifled by arcane restrictions and by “back to nature” environmentalists who tremble in fear of disrupting something that man does not know, and, according to them, can never fully know.

Individual rights are being smashed and trampled by the purveyors of collectivism and central planning, whose principal assertion is that individuals, without the sage guidance of authority, can never know what truly exists in the world, what is best for them, and how to attain it.

From academia, the messages of cultural relativism, political correctness, and egalitarianism are all unequivocal rejections of the rational faculty. There is no clear answer to anything, and all answers are equally good, these doctrines state. Furthermore, all *people* are equally good, and any person – or any cultural legacy, such as that of the Western Enlightenment – that tries to use Reason to become *better* and stand above the rest deserves to be brutally suppressed as either "imperialist" or "culturally insensitive".

To expect clear, unambiguous answers in both theory and practice, many individuals, disillusioned with the sorry state of contemporary humanities, try to flock to the "hard sciences" to find the guidance of Reason that every man needs to survive and prosper in this world. What they find instead is another species of denial of the objectivity of the senses and reality.

Contemporary science has, in many of its generally accepted theories, ceased to be guided by the principles of the Enlightenment, and instead has assumed the doctrines of one, Auguste Comte, an early 19th-century socialist, admitted opponent of individual rights, and the father of positivism, who also sought to fragment and compartmentalize all knowledge and to reject the necessity of philosophy in defining the contours of any discipline.

To Comte, the era of the "metaphysical" had been rendered obsolete by the hard sciences, and the only way forward was for the sciences to reject the foundations of knowledge explicated during the Enlightenment and for each of them to develop their own highly particularized principles independent of one another.

That is, Comte´s doctrines ushered in the contemporary era of ultra-specialization in which the biologist is oblivious to the work of the physicist, the mathematician knows nothing about what happens in the field of chemistry, the engineer cares little about the abstract theory on which his work is founded, and many scientists are politically, culturally, and philosophically illiterate.

The Dangers of Scientific Orthodoxy

Essay LXXXVII

As a result of the application of the empiricist-positivist doctrines of Auguste Comte, the old Western ideal of the Renaissance Man, with a thorough foundation in every major discipline, has been replaced by the paragon of the idiot-savant, highly skilled in one narrow field and completely ignorant of all others.

No longer is the greatest prominence afforded to the Leonardos, Galileos, Newtons, Franklins, Goethes, and Borodins of this world, but not because our knowledge has grown too vast for one man to have a basic grounding in all of it, as the proponents of Comte's empiricist-positivist view would assert.

Quite the contrary, with today's capacity for computers and automated mechanisms to perform almost all of man's rote physical and intellectual busy work, never before have the possibilities for man's sheer erudition and creative application of his learning been greater.

The reason why the Renaissance Men are seldom respected and elevated any longer is because today's *cultural and intellectual state,* at its core, rules them out as not only impossible but also undesirable. It is because contemporary society, at all levels including the scientific, rejects either the possibility or the necessity of objective, rational philosophy setting the terms on which further inquiry and progress are to take place.

And today´s anti-philosophical, anti-moral purveyors of orthodoxy, with all their compartmentalized erudition, are what have made and still make possible massive travesties of justice on all levels. They are the men who, while brilliant in their narrow fields, have made no attempt to realize that forging atomic weapons for totalitarian states, or allowing those states to exist in the first place, might not have been such a splendid idea.

More particularly, today's scientific orthodoxy has become akin to a Medieval priesthood, highly exclusive and treating all "lesser men" with a ludicrous snobbery, as if anyone not versed in its arcane doctrines is not qualified to speak on any subject whatsoever using reason and common sense, as if that person needs to be shut down and automatically discredited for refusing to accept the authority of contemporary "experts" uncritically and on faith.

Just because most do not understand the nuances of quantum mechanics, today's purveyors of orthodoxy state, they do not understand anything, and are thus excluded from ever knowing truth. The truth, of course, is that, even as Max Planck himself had admitted, nobody truly understands quantum mechanics, because the doctrine is not properly formulated nor adequately connected with the world of everyday sensory perception.

Why Predictive Power Does Not Imply Correctness in a Scientific Theory

Essay LXXXVIII

Using the evidence in previous essays, a man of reason can see that, whatever their useful practical applications, the conceptual core of relativity, quantum mechanics, modern "cosmology" (i.e., the same apocalyptic dogma about the "end of the universe", rehashed in modern, scientific-sounding terms), and "string theory", is riddled with contradictions, inconsistencies, and sheer impossibilities that strive to blatantly violate the reality which man observes with his senses during every moment of his life.

What the orthodox contemporary scientists refuse to understand is, simply because some theory has produced useful practical results, does not mean that the theory is correct. Consider that the healing properties of certain herbs, for example, were known for millennia among certain extremely backward tribes of the Amazon.

Let us presume that a hypothetical Western visitor to one of those tribes were to be met by the local shaman and told of a powerful theory that has never failed to heal a certain type of wound. The theory is called "Spirit Dance".

Whenever somebody is injured, the shaman takes his magic pouch (filled with the healing herb) and places the afflicted person in a special ceremonial circle made of an exotic stone that had to be pounded into the ground exactly twelve times to get its remarkable properties from the Great Spirit.

Then, the shaman must wear the hide of a beast slaughtered exactly thirteen days prior to the injury, and hop around the circle for six hours on one foot, chanting praises to the Great Spirit. Subsequently, he sprinkles his magic herbal powder onto the victim's wound, and punches the victim in the stomach three times to infuse the Great Spirit's strength into him. Behold the great miracle: the victim's wound will become healed!

The shaman will object with indignation to the visitor's claim that all of his services are in fact unnecessary, that a moment's application of the herb powder by any individual would itself suffice to cure the wound, by a theory that rules out the superfluous, mystical, illogical, and simply absurd.

It is true that his theory works within the given context, but it works far less effectively than a theory which is grounded solely in the nature of reality and the existents involved in the process. While the six-hour delay might not severely harm a patient with a minor cut, it will kill somebody injured more severely and capable of bleeding to death during that time.

Aspects of the false theory can also be harmful: punching most people in the stomach will not always result in injury, but it could kill a pregnant woman, for example. The Great Spirit could also be used as a justification for other, less benevolent acts, including human sacrifice and the establishment of an authoritarian social hierarchy whereby the shaman uses his exclusive "bond" with the Spirit to render the populace dependent on him and believing that he has divine authority to govern their lives and stifle dissent.

Similarly, the contemporary empiricist-positivist scientists, and their all-too-eager collectivist allies in the humanities, seek the same sort of impregnable dominance over others in the creation of arcane "refutations" of reason and common sense. Relativity and quantum mechanics, because of their certain useful practical results, are often invoked to disqualify the absolute views of space and time, views which are implicit and self-evident in our daily lives.

But which theory predicts the world around us more accurately? Is it the theory that states that all entities are material, or one that posits entities with zero mass, or with infinite density, or with zero volume? Is it the theory that recognizes only three spatial dimensions or the one that posits eleven? Is it the theory that views force fields as mere convenient abstractions, or as an infinity of infinitely overlapping entities with infinite expanse? Let the reader try *living life* based on the theoretical underpinnings of post-Classical physics, and he will see how absurd and incompatible with the real world such theories are.

The Dangers of Faith in Scientific Experts

Essay LXXXIX

There are grave problems with trusting on pure faith the pronouncements of scientific "experts". If there is no way to interpret existence by the intelligent layman using reason and common sense, then it must follow that said layman must refer to the orthodoxy for assistance. But, instead of receiving assistance, he will enter a state of dependence on and subordination to "expert authority".

While the Enlightenment thinkers have urged man to become autonomously educated about the world around him by keeping his senses alert and his Reason functional, the message from the current orthodoxy is: do not think, do not question, do not investigate; you are too shallow, uneducated, inexperienced, or simply possessed of the wrong hyper-specialization to know anything by yourself in the first place. Trust us, give us money, or, better yet, *power* over your mind, and *we* will give you the answers. And these answers will define the nature, meaning, and purpose of the most fundamental aspects of your existence.

The answers, of course, change from one day to the next, since there are no immutable fundamentals and truths certain beyond possibility of refutation, and every next highly particular observation will produce a "paradigm shift", as if the discovery of a new subatomic particle can ever alter the fact that A=A. This, of course, guarantees that the answers everybody received from the orthodoxy yesterday are today obsolete, and the layman needs to perpetually come back for more.

Rational cosmology is a tool of individual liberation. Properly applied, it will shatter the layman's dependence on empiricist-positivist orthodoxy for the answers, and will allow each man to renew both his confidence in and his understanding of the correctness of his sensory perception of the existence in which he operates.

We perceive space as three-dimensional, because it is. We perceive time as uniform, absolute, and analog, because it is. We perceive motion as continuous and analog, because it is. Our sensory responses to sound and light, our necessary conceptions of mass and volume, of the origin of forces in interactions between two entities, of the impossibility of simultaneous infinities and non-local effects, are what they are because they reflect the absolute, objective nature of reality.

Whenever a given proposition seems absurd or counter-intuitive, it is because it either blatantly or subtly disregards the data of the senses or the integrity of logic. There is no higher truth in contradiction and inconsistency; there is only the attempt to obscure truth. Rational cosmology empowers man by affirming that he is equipped from birth with both the sensory capacity and the conscious mind to seek out and find out everything he needs to live and to prosper.

The three-dimensional nature of space implies that there is no "hidden dimension" that we cannot examine, and whose secrets will forever remain hidden from us. The one-dimensional, absolute,

uniform nature of time implies that we can always be certain that a second today will equal a second tomorrow, that the fundamental rules governing change, motion, and, indeed, life itself, will always remain true and at our disposal.

The ubiquitous qualities of entities imply that there are definite elements to all existents that we can always rely on; we can always fathom mass, volume, length, width, height, and time, and these qualities will give us reliable indicators as to what entities are, how they can be found, and how to begin investigating their particulars in greater depth. The elucidation on what the term "universe" means will allow us to soundly lay aside the ridiculous notion that existence itself had to somehow be created (a logical absurdity) and is doomed to be destroyed.

The Possibility of Eternal Progress

Essay XC

Apocalyptic dogma has existed since the beginning of human civilization, trying, in sheer envy and malice, to condemn aspiration and progress as futile because everything is someday doomed to come to an end.

Rational cosmology affirms the truth about reality: entities come to be and pass away because of their particular natures, not because this is some universally dictated inevitability. Nothing *has* to end except as governed by the behavior of its constituent qualities. If one changes an entity's qualities, one changes its fate.

Not only is the universe not doomed, neither is man. The physicalist view of life, consciousness, and volition implies that man has the full potential, ability, and freedom to expand the abilities of his own organism through both organic and mechanical enhancements. These abilities include the broadening of his capacity to resist the forces of death and decay which afflict his body and mind.

Over the ages, this phenomenon has indeed occurred, as rational science has increased man's average life expectancy about fivefold, from the late teens in the Paleolithic era to the late seventies and early eighties today. There is no reason to presume that there is a "cap" on this ability to win temporal territory from the abyss of non-existence.

Quite the contrary, the foundations of existence all suggest that indefinite longevity is there for the taking, if only man were to renounce all inferiority complexes and realize that no pursuit in self-improvement, however ambitious, is futile or beyond his grasp. He has all the tools, and the ability to build new ones, needed to discover the answers to the greatest questions, to construct the most life-enhancing machines, to alter the nature of his environment so as to please him and enrich his existence.

But, as the great Sir Francis Bacon noted, "Nature, to be commanded, must be obeyed." To learn how to manipulate the elements, one must first know how they function. To get to the stage of manipulating particular elements, one must know fundamental, logical, irrefutable, and

ubiquitous truths about existence itself. This is where philosophy in general, and cosmology in particular, come in.

Without the guidance of general, abstract principles for understanding where he is, who he is, why he is, and what he ought to do, man, even when armed with the most complex technology and the best particular observations of his day, is helpless – for the technology and the particular observations must serve his philosophically grounded and volitionally chosen purpose, not the other way around.

Only when armed with the certainty provided by a philosophical understanding of the fundamentals of existence can man become impervious to the allure of authority, the soothing promises of experts who seek to liberate the individual from the responsibility of thinking for himself, and thereby to make a willing slave of him.

The philosophically enlightened man can "specialize" and succeed in anything, and the greatest minds of history knew this. Leonardo's art, Newton's physics, Goethe's drama and poetry, all towered above the common denominator because these men knew the value of philosophy in every human endeavor; they knew that only abstract, rational principles can bring about unerring consistency in whatever line of work one seeks to pursue, and they applied those principles with honesty and precision.

Man is born *tabula rasa*, says rational philosophy. There is nothing that prevents him from being the next Leonardo or Newton, save the lack of willpower and confidence to do it. And it is this confidence in himself and in the immutability of the principles governing his world that man needs to develop. May rational cosmology assist him in such a worthy task.

Chapter XIV
Contemporary Physicists' Faulty Definitions of Matter

Definitions of Matter: Rational Versus Post-Classical

Essay XCI

Some time ago, I applied my rational cosmology to an extensive discussion on the now-defunct Autonomist Forum, in response to questions asked about my theory. I adapt these responses here, in a systematic presentation of some of the flaws of the contemporary orthodoxy in physics. My hope is that every rational scientist, philosopher, and layman reading this will come to understand the need to conform scientific investigation to the rigors of logical thinking.

Alexander, an intelligent and thorough poster, contrasted my definition of matter in *A Rational Cosmology* to the prevailing definition used by modern scientists. My definition, from Essay

XIII: "The Ubiquitous Quality of Matter", is as follows: "Matter is .... the *constituent quality of entities.* Matter is, simply, *that, which entities are made of, and without which they cannot have any other qualities.*"

I further elaborate on this:

> "It is not the province of ontology or cosmology to describe what the fundamental 'building blocks of matter' (i.e., the entities that would represent Democritus's concept of 'atomos') are. The specific-observational sciences must discover whether such fundamental building blocks exist, how many types of them there are, and how they look like and behave. Cosmology has only to point out that matter *exists,* and *exists as a quality of every entity.*"

My definition of matter has implications for the concept "mass". *Mass* is simply the measurement of matter; any entity which has any of the constituent quality "matter" will have some measurable mass that it will exhibit at all times. The mass can change magnitudes, if it is gained from or lost to other entities, but it must always have some positive magnitude. If an entity ever has "zero mass", like a "photon" at rest, it ceases to exist. This is why a "photon", under the very premises from which post-Classical physicists derive the idea, cannot exist.

In contrast to my definition, Alexander presented the mainstream "scientific" definition of matter: "Something that has mass and exists as a solid, liquid, gas, or plasma" (Dictionary.com). Furthermore, he provided the post-Classical definition for "mass":

> "*A property of matter equal to the measure of an object's resistance to changes in either the speed or direction of its motion. The mass of an object is not dependent on gravity and therefore is different from but proportional to its weight*." (Dictionary.com)

He then concisely illustrated the essential differences between my definitions of "matter" and "mass" and the post-Classical definitions:

> "*It looks like one reason you're having so much of a problem with post-Classical physics is because you and scientists are working from different definitions of matter and mass. To them, matter is atoms and above. To you, it's whatever has mass. To them, mass is indicative of how much resistance to change a thing exhibits. To you, it's how much 'stuff' there is, however you would measure that*."

This is a fair contrast to make. It is also a proper beginning to my illustration of how the post-Classical definitions are riddled with logical fallacies.

Errors in the Post-Classical Definition of Matter

Essay XCII

Many post-Classical physicists define matter as "something that has mass and exists as a solid, liquid, gas, or plasma" (Dictionary.com); they further define mass as "A property of matter equal to the measure of an object's resistance to changes in either the speed or direction of its motion" (Dictionary.com). Both of these definitions are erroneous, as the following analysis will show.

Matter as Primary to Mass

Let us first examine the error in the first part of the contemporary physicists' definition of "matter." In claiming that matter is "something that has mass", they define matter in terms of mass. This is a reversal of essentials, a putting of the cart before the horse, so to speak.

Matter is fundamental to mass, not the other way around. Mass is a measurement of matter; it is a derivative attribute of all material entities. We know, by corollary, that every material entity will also have a mass measurable by some means. However, it has mass because it is material. It is not material because it has mass. That would be akin to defining an entity with length as "an entity that has meters," or a moving entity as "an entity that has meters per second." The measurement necessarily follows from the quality, not the other way around.

The better definition in this context would be a definition of mass as a "universal measurement of matter, which all material entities exhibit."

Entities as Primary to Relationships

Furthermore, I take issue with the second part of the post-Classical definition of matter as that, which exists as a solid, liquid, or gas. "Solid", "liquid", and "gas" are *relationships*, involving many entities. Wherever there is a collection of like entities (such as atoms or molecules), we could call their relative arrangement a "solid", a "liquid", or a "gas", depending on the particles' proximity and the types of bonds (if any) between them.

The second part of the definition of matter as "solid, liquid, or gas" is, again, a reversal of essentials. One cannot define an entity in terms of a relationship, because that would put relationships as a primary to entities. But relationships are always *derivative* from entities. A relationship cannot exist without the entities that relate. There cannot be a solid, liquid, or gaseous relationship without the material entities that form such a relationship. To define the relationship as primary to matter itself would beg the question, "What is it a relationship *of*?" The post-Classical physicists' answer? Blank-out.

The fact is, individual atoms and molecules can be neither solid, nor liquid, nor gaseous in isolation from other atoms and molecules. Yet they are composed of matter, nonetheless. If they were not composed of matter, they would not have any constituent quality, and would therefore not exist; they would be just an arbitrarily defined region of empty space. Thus, the post-

Classical physicists' definition of matter fails on both counts: neither mass nor the solid, liquid, or gaseous phases are primary to matter itself.

The Superiority of the Rational Definition of Matter over the Prevailing Definition

Essay XCIII

Rational cosmology's definition of matter as the constituent quality of entities is superior to the post-Classical physicists' definition of matter as whatever has mass and exists as a solid, liquid, gas, or plasma, because it is more fundamental. It encompasses all entities in existence and does not beg the question of what the lesser, "immaterial" entities are made of. It also conveys useful knowledge: the fact that all entities have a measurable mass, which is a manifestation of their quality of matter.

It is futile to speculate about the *causes* or *constituents* of matter itself. The very question is absurd. Matter itself is an irreducible primary; it can be neither created nor destroyed. It is simply *there*, and it can be *measured*. Matter is always a quality, and a quality cannot exist apart from the entities which it comprises. We can legitimately ask whether a given entity, thought to be "fundamental", can be divided into further smaller entities. But each of the subdivisions will always be smaller entities, composed of the fundamental quality, matter.

Now, we proceed to the physicists' prevailing definition of "mass", and how said definition is flawed.

Matter as Primary to Inertia and Gravitation

For the reader's convenience, I will again present the conventional post-Classical definition of mass: "A property of matter equal to the measure of an object's resistance to changes in either the speed or direction of its motion. The mass of an object is not dependent on gravity and therefore is different from but proportional to its weight."

The problem with this definition is, again, the reversal of essentials. One aspect of material entities is resistance to changes in speed or direction. This is Newton's undeniable First Law. However, it is not *primary* to matter, but rather *derivative* from it.

Resistance and change are relationships, and they imply material entities that resist and change. The material entities are primary to the resistance and change, and matter is the quality which enables them to resist and to change. Furthermore, matter is the quality which enables objects to attract each other with a gravitational force. This is why matter itself is unaffected by gravity. It is the *cause* of gravitation, and the effect (gravitation) can never cause its own cause (matter).

To put resistance and change as primary to matter is to raise the question, "Resistance and change, *of what*?" The post-Classical physicists' answer? Blank-out.

"Stuff"

Alexander on the now-defunct Autonomist Forum was right to suggest that, in my view, mass is the measurement of the "stuff" entities are made of, if this "stuff" is considered to be a quality of entities. The "stuff" that mass measures is matter, of which all entities are composed. The way one measures that "stuff" is by using instruments which measure mass.

One cannot "explain" matter further, except by pointing out that it exists, it is measurable, and that all entities are comprised of it. One can explain the *effects* of matter, such as inertia and gravitation, but always as derivatives, not as primaries. Material entities cause inertia and gravitation by virtue of their matter, not the other way around. Matter itself just *is;* it is an irreducible primary.

The Philosophical Error

In their flawed definitions of matter and mass, the post-Classical physicists have erred because they have neglected logic and philosophy. Logic and philosophy take great care not to confuse derivatives with primaries. The derivatives follow from the primaries, and are defined in terms the primaries. The primaries cannot be defined in terms of the derivatives. They can either be defined in terms of still more fundamental primaries, or, like matter, be irreducible primaries that cannot be further dissected.

Because matter is such a primary, defining it in terms of its effects is absurd. If matter is defined in terms of its effects, and its effects can only be defined in terms of matter, we have an irresolvable circularity. On the contrary, if matter is defined as the fundamental, constituent quality of all entities, then all its effects follow cleanly from such a definition.

Chapter XV
Light is Not a Particle

Why Experiments Cannot Prove that Light is a Particle

Essay XCIV

Here, I shall demolish the first part of one of the most fashionable and least correct post-Classical scientific theories: the "particle-wave duality" of light. Earlier, I had proved that light cannot be a particle. I shall reiterate my proof here and elaborate upon it:

> "A particle is an entity. It should be recalled... that matter is one of the ubiquitous qualities of entities. Mass is the measurement of matter, yet light is massless. Light is not an element on the periodic table, nor is it a subatomic particle, such as an electron. Light lacks mass, thereby lacking one of the ubiquitous qualities of entities, thereby not being an entity. Light also lacks all other ubiquitous qualities of entities, including volume and

any measurement in any of the three dimensions. One could hardly say, 'this beam of light is half a centimeter wide, twelve centimeters long and two centimeters tall.' Thus, light thoroughly fails the test for being categorized as a particle."

What of the Experiments?

The first question most would ask in response to my argument above is, "But have not ample experiments *proven* that light is a particle?" No, in fact, they have not. They *could not have* and *cannot.*

Experimental apparatuses might detect light in ways similar to those in which particles might be detected, but it does not follow from this that light is a particle. That would be analogous to saying that experimental evidence has shown that a cat has four legs, just like a dog, and that a cat's locomotion is remarkably similar to a dog's. If this were all the evidence we had about cats and dogs (analyzed through an experimental device that can only study locomotion and the number of an entity's legs), we would not be able to conclude that a cat is a dog, or vice versa.

Experiments, as highly particular observations, are insufficient for establishing essential generalizations, on which any ubiquitous, universal understanding of an existent is based. The mistake experimentalists most often make is the *non sequitur*, claiming that a given theory follows from some particular evidence, when it in fact does not.

The experimental evidence explains that, which was being experimented on; particular observation explains particulars. It does not and cannot explain ubiquitous elements of existence, such as the ontological classification of light. The particular evidence is necessarily too narrow to make ubiquitous generalizations from it.

What contemporary physicists are in fact doing is *presupposing* that light is a particle, interpreting their experimental data on the basis of that presupposition, and then claiming that this data – interpreted under the premise that light is a particle – "proves" that light is a particle. This, of course, uses the particulate nature of light to "prove" the particulate nature of light – an inadmissible circularity.

All that the experimental data in fact shows is that light interacts with certain experimental devices in certain ways under certain conditions. Such data can be interpreted in any multitude of ways by a multitude of theories. To determine *the* correct theory, one must be sure that it not only fits the experimental data, but that it also does not contradict anything else one knows.

If one's ubiquitous observations about light are evidently incompatible with a given theory that happens to fit the particular experimental data, then the theory, not the ubiquitous observations, must be rejected. Another theory must be devised that fits *both* the observations and the data. Developing such a theory is the task of philosophers – namely, rational cosmologists – since the specific-observational sciences deal with only particulars through experimentation.

Ubiquitous Observations Refuting the View of Light as a Particle

Essay XCV

The theory that light is a particle contradicts several critical ubiquitous observations.

All particles must have mass, since particles are entities. A particle without mass would be composed of "nothing", and would therefore not exist. Post-Classical science follows Gilbert N. Lewis's 1926 definition of the "photon" as a fundamental particle of light. The "photon", under the particulate model of light, has "zero rest mass", which means "it" has no mass, which means "it" is composed of nothing, which means "it" does not exist.

Entities do not "magically" gain mass just by moving, for that would amount to creation *ex nihilo*, a logically contradictory and inadmissible proposition, as shown in Essay XXVI: "The Impossibility of First and Last Entities". But creation *ex nihilo* is precisely what the prevailing view of light as a particle would imply: at rest, the "photon" has zero mass, but it suddenly gains mass in motion! Clearly, a scientific theory that invokes spontaneous generation of matter needs to be reconsidered and reformulated at the least.

Evidently, some other theory is needed to describe the nature of light – a theory which does not presuppose light to be a particle.

All particles must have volume, since particles are entities. A particle without volume would exist "nowhere", and would therefore not exist. Light does not have volume. Therefore, light is not a particle.

All particles must have measurements in three spatial dimensions; anything less is inconceivable. But light has no measurements in any dimensions. Essay XLIII aptly illustrates this: "One could hardly say, 'this beam of light is half a centimeter wide, twelve centimeters long and two centimeters tall.'"

No human being can consistently conceive of entity with fewer than three dimensions. Every man is a three-dimensional entity, and all the entities he observes exist in the same reality as he. In order for his body to interact with them, those entities, too, must be three-dimensional.

One can *abstract* two or fewer dimensions from a three-dimensional entity and analyze those qualities of that entity, but one cannot reify that abstraction into an entity in itself. There is no way that such a reified abstraction could ever form a complete entity. An entity with no length, width, or height would have the same problem as an entity that has none of those qualities: it would have no volume and thus would not be able to exist anywhere. Where would it exist, if it did not have volume?

Light does not have measurements in three dimensions; therefore, light is not particulate.

Observations of Light's Lack of Mass and Volume

Essay XCVI

On the now-defunct Autonomist Forum, a poster, Alexander, challenged the first ubiquitous observation which leads to the refutation of the particulate model of light: the claim that light has no mass. Alexander wrote: "The claim that light has no mass was not entertained as a fact prior to experiment or theory, nor can we verify it with our senses unaided. Perhaps the theory is incorrect or the observations flawed."

There are several observations that can help us understand why light cannot have mass.

Conservation of Mass: If light had mass, the source entities emitting it would *lose* mass, whereas the target entities receiving it would *gain* mass. By implication, if we lit a room using a multiplicity of light sources and returned after a long time to it, we would observe a "coating" of "light particles" on the floor, since the floor would have been continually targeted by the light sources. Yet no entity gains mass or a coating of "light particles" upon illumination. Thus, we may conclude that light has no mass.

Critics of this argument might respond that perhaps these light particles *do* accumulate, but they are too small to be visible by the naked eye. I respond that, if this were a possibility, we would be able to clearly discern collections of such particles by means of microscopes -- which we still have never been able to do.

Behavior at Near-Absolute-Zero Temperatures: If light had mass, it would be solid or near-solid at near-absolute-zero temperatures (approaching -273.15 degrees Celsius), which have been obtained in laboratory conditions. Since light is in no way affected by approaching absolute zero temperature (under which all motion of particles ceases and material elements can actually form perfect solids), it is not a material entity.

Observations of Light's Lack of Volume

There is no conceivable way in which one might attribute "volume" to light in the same way one might attribute volume to solids, liquids, gases, or individual particles. One can see light as exhibited by source and target entities, but one cannot see light *qua* light. Nor does one have any indirect indication of the presence of light between source and target entities. Indeed, where there are no entities, there is no light, just like where there are no entities, there is no motion or any other relationship.

All this suggests that light is a relationship, not an entity, and relationships cannot have qualities *qua* relationships. Volume, on the other hand, is an essential quality of any *entity*. Thus, because light does not have volume, we must conclude that it is not an entity and thus also does not have mass, because anything with mass must have volume. Light can only be a relationship, by process of elimination.

Why Spin is Not the Defining Characteristic of Particles

Essay XCVII

Here, I shall refute the prevailing view among today's physicists that *spin* rather than *matter* is the defining characteristic of a particle. Indeed, the primary attribute of any entity, including particles, is matter, measured by mass.

Eddie Wood on the now-defunct Autonomist Forum challenged my argument that all particles must have mass, instead putting forth the post-Classical physicists' view of "spin" as the defining characteristic of particles. He wrote:

> "*Your argument rests on insisting on a certain definition of 'particle' which is not very informative. You insist that a particle (or any entity) must have mass and if it doesn't have mass then it is not a particle (or entity). Yet if you look at the fundamental particles, you will see that the common characteristic they all have is spin, not mass. The photon just happens to be the only known elementary particle that doesn't have mass*."

Again, the post-Classical physicists have committed a philosophical error: the reversal of primaries and derivatives. In reality, entities are primary to relationships, and relationships are defined in terms of entities. However, under the post-Classical definition, a relationship, "spin", is wrongly considered primary to entities, and entities are defined in terms of it.

Spin cannot be a fundamental characteristic of particles, because "spin" presupposes that, which is spinning. Nothing can spin without a constituent quality that enables it to spin. Spinning is a relationship, and all relationships require certain qualities to make them possible. In the case of spin, such a quality is matter, of which mass is an index. Nothing can spin without being massive, i.e., without being composed of anything whatsoever.

The idea that "spin", rather than mass, is a fundamental constituent of particles, is an example of the same fallacy Ayn Rand thoroughly debunked in *Atlas Shrugged*: the idea that the fundamental "elements" of the world are "change", "motion", and "action".

Rand brilliantly showed that one cannot have change without that which is changing, motion without that which moves, action without that which acts. Entities are primary to relationships, and relationships can only happen by virtue of qualities. Spin is a change of position, i.e., a change of an entity's three spatial qualities. An entity can and must have the three spatial qualities (dimensions) by virtue of its volume. It can only have volume if it has mass; a mass-less entity with volume would just be some arbitrarily delineated region of empty space (or "space-as-absence").

In further clarification of his position, Mr. Wood wrote: "When I say that light has a spin, or any elementary particle has a spin for that matter, it really means that light has an intrinsic angular momentum."

Yet angular momentum is a mathematical expression of a relationship which depends on mass to exist. The angular momentum, L, of a rotating object is defined as L= m*v*r. Angular momentum is a simply a relationship equal to the product of an entity's velocity (v), its "moment arm" (r, the perpendicular distance from the point around which it rotates), and its *mass* (m). Any entity that has zero mass would have its angular momentum equal to 0*v*r, which is, of course, zero. If light does not have mass, it cannot have angular momentum, so – even by that definition – it cannot be a particle.

Of course, defining particles in terms of angular momentum is again a reversal of essentials. Matter is primary to angular momentum; angular momentum cannot be a relationship of immaterial entities. Matter should thus be the defining characteristic of all entities.

The Possibility of Quantifying Light and Other Relationships

Essay XCVIII

Previous essays have shown that light is not a particle but rather a relationship; yet it is also known that light can be measured and quantified using such models as the electromagnetic spectrum. How can these two facts be reconciled? Can relationships be quantified? Indeed, they can.

Amounts of a Relationship

It is known that source entities can emit different amounts of light. On the now-defunct Autonomist Forum, a poster, Alexander, asked me how it is possible to attribute "amount" to light if light is not a particle. Since I reject the particulate view of light, I claim that light is not an entity, but rather a relationship at a distance between the source of light and its target entity. Alexander inquired:

> "*[Mr. Stolyarov] further alleges that light comes in different amounts--we all know how he means this--yet the usage of that term begs the question, for me at least. What other phenomenon could we apply the term 'amount' to without having to specify quantity (i.e. number of entities)?*"

Attributing "amount" to relationships is quite possible. We can discuss "amounts" of light in a similar manner to discussing "amounts" of force and motion, even though neither of these are entities. They are all relationships between multiple entities or between an entity and its former state (as is motion).

What we need to discuss "amount" is not *entities*, but rather *units of measurement*, some of which can be used to measure qualities and relationships as well. This is why the electromagnetic spectrum is important: though it makes the fundamentally false assumption that light is a wave, it does reveal that light is *quantifiable*. One would only need to change the name of the unit of light from "wavelength" to "unit of light", and the spectrum model will be fundamentally sound.

Can We Point at Light?

Alexander further asked me how it would be possible to point at light and identify it, if light were not an entity composed of particles. He wrote: "We do not point and say, 'that's a relationship.' That is usually the word designating a particular explanation we have, rather than one we use to describe that which we sense."

Alexander is correct to say that it is impossible to "point" at a relationship. Likewise, however, it is also impossible to "point" at light. We cannot do this with light any more than we can do this with motion. We can point at moving *entities* or illuminated *entities*, but we cannot point at *motion itself* or *light itself*. To identify relationships requires our conceptual faculty, which can abstract the relationships from the entities themselves. Looking and pointing does not suffice.

The Danger in Reifying Analogies

Essay XCIX

Here, we shall discuss the dangers of conflating a model for a natural phenomenon with the phenomenon itself. While the particulate model of light might convey some useful information about light, such a model is not a description of light as it actually is. Many of today's scientists commit the fallacy of reification by asserting that a useful model for a phenomenon is equal to that phenomenon.

Reginald Firehammer, owner of the now-defunct Autonomist Forum, commented on the discussion regarding light by stating that, while he does not assert that light is "particles" or "waves", it "has characteristics which can be comprehended by 'picturing or modeling' light as particles or waves."

I do not deny that modeling light as particles or waves in certain conditions might lead to practically useful knowledge. I do not deny the valuable applications of said knowledge in engineering, optics, and computer design, for example.

However, these models give us no true information about what light actually is – any more than ball-and-stick models give us true information about what atoms actually are. The problem with contemporary physics' approach is not so much with the use of these models, as with their reification as *actual properties* of light. Such reification then is used to absurdly reject the law of non-contradiction (which states that the same entity cannot be both a particle and wave, for example, or that massless entities cannot exist, or that waves in vacuums cannot exist).

The particle and wave models are, at best, useful analogies. I do not object to analogies as such, so long as their limits are clearly recognized. Every analogy breaks down at some point, because the thing compared is inherently unlike the thing it is compared to, as I explain in my essay "The Virtue of Directness in Literature".

Most importantly, *the truth cannot be understood by analogies alone.* It can only be grasped by understanding the relevant entities, qualities, and relationships *qua* entities, qualities, and relationships. Science should not deal with analogies *primarily*, except to supplement and more easily convey direct insights into the nature of what it studies.

My theory, as developed in *A Rational Cosmology*, goes beyond analogies to understand what light actually is and to derive this understanding from evidence that is unavoidable in the course of everyday existence, provided one uses one's reason to properly interpret it. However, my theory is also more fundamental: it does not explain non-ubiquitous particulars, but non-ubiquitous particulars *are* consistent with it and can be better understood through my theory.

As a philosopher, all I am able to say is that light is a relationship and that this relationship has certain known, ubiquitously observable properties. Anything beyond that is the realm of particular observation, and is the rightful object of scientific investigation. However, no specific-observational scientist may legitimately dispute the validity of the ubiquitous observation and must work to ascertain that his particular explanations do not contradict it in any way. In this manner, a reality-consistent understanding of particulars might also be attained.

As a (hopefully useful) analogy, consider my theory to be like the delineation of the boundaries of a largely unknown, unexplored territory. This delineation tells all would-be particular explorers: "Everything you find out about this particular subject will be within these boundaries and cannot exceed them. However, whatever is within these boundaries is admissible as a valid and useful finding." I am responsible only for mapping the boundaries, not examining everything within them in exhaustive detail – though I assure you that, if examined in the context of my theory, all the particular phenomena concerning light will begin to make much more sense.

Chapter XVI
Light is Not a Wave

Contradictions in the View of Light as a Wave

Essay C

This essay will begin to do away with the second part of the false particle/wave duality of light – the fashionable view among post-Classical physicists which is often used to justify discarding the laws of identity, causality, and non-contradiction. In Essay XLIII: "Why Light is Neither a Particle nor a Wave", I had refuted the view of light as a wave thus:

> "A wave is a relationship of entities, a periodic disturbance of them. In order to travel from point A to point B, a wave has to encounter *continuous entities to periodically disturb*! Sound waves, for example, encounter such a continuity of entities in the form of air molecules. However, in a vacuum, where no such continuity is present, neither is there sound."

> "Light, on the other hand, *can* be made manifest through a vacuum, an observation requiring no highly specialized study. One needs only look out into the night sky and realize that one is seeing celestial objects separated from the Earth by billions of kilometers of the near-total vacuum which is space. Yet, somehow, light enables one to see them nonetheless!"
>
> "The Sun is separated from the Earth by some 150 million kilometers of vacuum, yet its light not only is perceptible on Earth, but is the primary source of light here, and the precondition for all life on this planet. Thus, vacuum is not only no impediment to light, but light must be quite adept at transcending vacuum in massive quantities."
>
> "The objection might be raised that outer space is not a complete vacuum, but that the occasional gas molecule does appear there. However, there is certainly not a *continuity* of *any* type or combination of particles beyond the reach of a given planet's atmosphere, and a wave relationship, in order to be exhibited, requires a continuity of particles that exert contact forces on one another. Two hydrogen molecules five hundred kilometers apart will not produce a wave relationship. Thus, in order to transcend a vacuum, light cannot be a wave, but rather must be *some other phenomenon.*"

Presently, I shall expand on this refutation; in this and subsequent essays, I will show exactly where post-Classical scientists have committed the error that led to their classification of light as a literal "wave".

The post-Classical scientists' error is twofold. It falsely identifies the relationship of light as equal to another relationship which accompanies it: electromagnetic force. Furthermore, it reifies the model describing such electromagnetic force and tries to pass off that model as an actual existent in itself.

On the now-defunct Autonomist Forum, I was asked whether it is proper for a non-experimental philosopher like myself to challenge scientists' interpretations of experimental data and their theories about parts of observable reality, such as light. The implication behind the question was that reasoning alone does not suffice to understand light, and that the highly particular observations of experimentalists are needed to make *any* sense of it.

I disagree with this premise. Philosophers *are* equipped to determine the nature of light, because they actually *observe* light through their senses in an unavoidable manner. They have all the data they will ever need, and nothing is capable of contradicting that data. They also have other data which are just as important: data on the ubiquitous qualities of entities, which lead to the conclusion that all entities must have matter, volume, length, width, height, and time.

Rational philosophers also understand that waves are relationships: they are systematic vibrations of *particles*. My theory states that wave/particle "dualities" are impossible, since a particle is an entity, and a wave is a relationship.

Light cannot be both a particle and a vibration of particles. That would violate the law of non-contradiction, just as a moving entity cannot be motion itself – to illustrate the absurdity of the

particle-wave duality by a more explicit analogy. No existent can be both an entity and a relationship, even if the "entity" parts are clearly distinguishable from the "relationship" parts. I cannot be a "moving person" in context X, but "motion itself" in context Y. The two are fundamentally distinct categories of existence.

Light cannot be a wave, because waves are systematic vibrations of particles. Yet light can be transmitted through a vacuum, where there are no particles. How can there be vibrations of particles (waves) where no particles exist (a vacuum)? This is another contradiction, which rules out the wave nature of light.

Why Light Cannot Exhibit Oscillations of Electromagnetic Properties

Essay CI

In an attempt to defend the wave model of light, Reginald Firehammer wrote to me on the now-defunct Autonomist Forum, claiming that light's "wave nature" is fundamentally different from the wave nature of a vibrating string, or of periodically vibrating particles, as in sound.

Mr. Firehammer suggested using the word "oscillation" rather than "wave" to discuss light's behavior. "Oscillation" is defined as "a regular periodic variation in value about a mean." Mr. Firehammer elaborated:

> "*The oscillating nature of light is the fact that over time, the magnetic and electrical characteristics vary with a specific period called its frequency. The reason the word 'wave' came to be used is because the particular periodic nature of the variation in the magnetic and electrical characteristics happens to be described as sinusoidal, the graphic representation of which is called a sine wave. The question, 'If light is a wave, what is it a wave of?' is a mistaken question, a mistake I admit I've made in the past. When light is described as a wave, it is only the periodic natures of its magnetic and electrical characteristics that are meant.*"

The problem with this explanation is that electricity and magnetism are forces characteristic of specific types of entities. Magnetism is characteristic of magnets and/or electromagnets. Light is neither.

Furthermore, electricity is characteristic of either the motion of a stream of electrons (as in electric current) or of entities which have more or fewer electrons than they do protons (static charge). No non-magnetic entity can have a magnetic field. No entity which is neither conducive to electric current nor statically charged can have an electric field.

Light is not composed of nor conducive to protons and electrons; thus, the designation "electricity" cannot be applied to it in any fashion. Light is not made of any element or compound with magnetic properties, either. Even under the mistaken "photon" hypothesis, light does not consist of magnets and electrons; a "photon" is thought to be something else.

So, how can there be a magnetic or electric "field" to light without the presence of the entities which can result in such a "field"? As shown in Essay LVIII: "Why Force Fields are Abstractions Only", a field is not an entity in itself; it is simply a convenient mathematical model for expressing force interactions between a given object and a known test particle placed at any distance from that object. A field, in other words, is a model describing a force *relationship* between the entity and a test particle. With light, what and where is the entity that is thus relating?

All metal magnets are composed of either iron, nickel, or cobalt. Light is not composed of any of these. All electromagnets involve a moving current of electrons, whose effects can be analyzed via the model of a magnetic field. Light is not composed of electrons nor of a material conducive to the movement of electrons. Light is neither a magnet nor an electromagnet; thus, it cannot exhibit magnetic properties or "fields". Since light nowhere consists of the motion of electrons or the uneven ratio of electrons to protons, light *qua* light also cannot exhibit electrical properties or "fields".

I have thus shown that light itself cannot exhibit the "electromagnetic oscillations" attributed to it by post-Classical physics.

Electromagnetic Oscillations as Relationships Exhibited by Light Sources Distinct from Light Itself

Essay CII

After proving that light *qua* light cannot have "electromagnetic oscillations" of its own, I must reconcile my theory with experimental evidence. Experimental data suggests that such "electromagnetic oscillations" accompany the transmission of light in all instances.

Reality brooks no contradictions; thus, it must be that experimental evidence ought to be explicable via rational cosmology's view of light as a distance relationship between source and target entities.

We know that light itself does not consist of electromagnetic oscillations; light, as a relationship, cannot exhibit "fields" or oscillations of those "fields". Only *entities* can exhibit "fields" – i.e., attract specified other target entities with certain magnitudes of force at certain locations.

Consider the origins of all known light; that is, consider the possible types of *sources* that can exhibit this light. There are two such sources: the first is chemical compounds that react with each other via a process known as combustion. The combustion reaction, as a byproduct, often emits light – whether it be the combustion of a fire, a candle, or the immense quantity of reactions among chemical components of the Sun.

The second type of light source is an object which conducts electric current: a light bulb, a light-emitting diode, or any other of a myriad of electrically powered man-made sources of illumination.

What do the two types of light sources have in common when they originate the relationship known as light? The answer: *the systematic motion of electrons*. In every combustion reaction, as in every genuine chemical reaction, valence electrons are transferred from some types of atoms to others.

All flames, produced in combustion, are conductors of electricity, due to the ionization of some of the particles partaking in the combustion reaction. Thus, those types of combustion reactions that produce light – as manifested by flames – are also conducive to the motion of electrons.

An electric current, like the one required for a light bulb to function, can, too, only be produced via the motion of electrons. Furthermore, anytime electric current is conveyed through a wire or other conductor, the resultant system exhibits the relationship of magnetism – a magnetic force that attracts or repels target entities in the vicinity. Moreover, any system that conducts electricity will also be able to attract or repel other electrically charged entities with an electrical force.

We thus know that electricity is the systematic motion of electrons, which occurs in all sources of light. This motion is necessary and sufficient to result in both an electrical and a magnetic force. It follows from this that an *entity,* the light source, produces these forces; light itself does not produce them.

An *entity,* the light source, is describable via the so-called electrical and magnetic "fields", which are but models stating that the source will attract appropriate targets via certain amounts of electrical and magnetic forces at certain distances from it. Light itself is not composed of electrons, and thus cannot exhibit electricity. Yet every light source *requires* the systematic motion of electrons to emit light. Thus, the *light source,* not light itself, may have electrical and magnetic properties.

The "electromagnetic oscillations" observed experimentally are, in fact, just another relationship between the light source and targets in its vicinity. The "oscillations of a field" are not real entities or processes, because there is no such real entity as a "field". An "oscillating field" is but a model that predicts the magnitude of the force on a given target particle at a given distance from the source. It differs from a regular "constant field" only in that the magnitudes of expected force at a given location change with time, and their change can be graphed to produce a sinusoidal pattern.

Furthermore, the electromagnetic oscillations produced by the light source do not imply that light, or any other relationship, can "travel" through space. Where there is no target entity, there is no force, and there is certainly no "oscillating force" or "oscillating field". A field describes *potentiality,* not *actuality;* at a location where nothing exists, a field only describes what would happen *if* something existed there.

Light Results in Illumination, Not Acceleration

Essay CIII

I have previously shown that the model of "electromagnetic oscillations" does not describe a property of light, but rather a set of predictions for the effects of the *entity which is also the light source* on potential target entities.

Furthermore, while the electrical and magnetic forces are relationships between the light source and some target entities, they are not equivalent to light itself. They simply always *accompany* the relationship of light, because every light source involves the systematic motion of electrons to bring about light.

Any force, whether it is a contact force or a force at a distance, can be described as a push or a pull. A force manifests itself by and only by accelerating the target entity affected by it. Newton's Second Law expresses this via the equation F=m*a, stating that the sum of the forces on an object is equal to the product of the object's mass and its acceleration. Because the infliction of a force on an object is unable to change that object's mass, the force relationship can only manifest itself by accelerating the object. By Newton's Third Law, *both* entities involved in a force pair are in fact the originators and recipients of the same magnitude of force, oppositely directed. Any acceleration will naturally alter the observable motion of an object thus accelerated, since that object's velocity will change with time.

So, if light itself were an "electromagnetic force", we would expect the very emission of light and its reception by a target entity to visibly affect the motion of that target entity. Yet no entity accelerates simply because it is illuminated.

Ubiquitous observation shows beyond doubt that the vast majority of illuminated entities originally at rest remain at rest once illuminated, and illuminated entities originally in motion do not change their motion upon illumination. Since they were not accelerated by illumination, and since every force accelerates its target entities, we must conclude that light is not a force; nor can light be the "oscillation" in the "field" pertaining to that force.

The electrical and magnetic force relationships are necessarily exhibited by every light source, because they are necessarily originated via the same phenomena – combustion and electricity – as light itself. This is why one can expect models that describe such relationships to accompany every instance of light.

But just because two phenomena have a similar origin does not mean that they are identical. Light is not a force, nor are all illuminated entities impacted by an electromagnetic force. Light is another type of relationship between source and target; its consequence is illumination, not acceleration.

We have thus explained experimental evidence of electromagnetic forces pertaining to light sources as compatible with rational cosmology's view of light as a distance relationship between

source and target. The view of light as a "wave" is a false reification of a mathematical model which describes changes in a property that accompanies light, but is not light itself. It is a double error: a misapprehension of what the model actually describes, and a confusion of the model with actual reality.

No relationship can be a wave without being the actual systematic vibration of particles. The post-Classical view of light as a "wave" is but the result of a series of logical fallacies misinterpreting experimental data. Only the guidance of rational philosophy can enable scientists to correct such fundamental errors.

Radio Signals Are Not Waves

Essay CIV

Post-Classical physicists' mistaken views of light as a wave, refuted in prior articles of this series, have adverse consequences beyond their misunderstanding of light itself.

These consequences extend to the misapprehension of all phenomena quantitatively related to light, including the misnamed "radio waves" and "microwaves" – neither of them waves at all. This error, caused by post-Classical physicists' neglect and at times willful rejection of philosophy, has spread so pervasively to the general public as to become enshrined in false popular terminology. This essay shall conclusively correct this error, thereby seeking to begin to undo the damage.

Radio signals are quantitatively related to light via the so-called electromagnetic spectrum – a model which is misnamed, because light itself is not an electromagnetic force. Nonetheless, some measurement of the relationship "radio signal" is quantitatively lower than some measurement of the relationship "light." (Radio signals are considered to have a lower "frequency" on the "electromagnetic spectrum" than light.)

Another observation that suggests that the radio signal is similar in kind to light is its ability to be transmitted through the near-vacuum of space – like light, and unlike a wave. A wave must be a wave of *something*, a systematic vibration of particles – particles which a vacuum lacks.

Thus, a radio transmission is not a wave, and the contemporary scientists' error in explicitly calling it a "radio wave" is even more grievous than their sometime attribution of wavelike properties to light. "Radio transmission" or "radio signal" are both far more proper names of this phenomenon.

Radio transmissions are relationships, similar in kind to light in that they are direct relationships at a distance between source and target entities. The source of the transmission – whether a cosmic source or a broadcasting tower on Earth – affects the target directly, at a distance. The target entity, the radio device, converts the transmissions into sound waves that can then reach the human ear.

But this conversion does not mean that the radio transmissions are waves in themselves. They are the relationship prior to the production of sound waves: the relationship which enables the radio device to produce sound waves in consequence.

The designation of direct relationship at a distance between source and target can be applied to all other phenomena on the "electromagnetic spectrum" as well: infrared and ultraviolet radiation, X-rays, gamma rays, television transmissions, and the misnamed "microwave radiation" – for which the name "microsignal" or "microtransmission" might be more appropriate. All of these relationships can be transmitted through a vacuum and have been shown to quantitatively relate to light.

The fact that phenomena such as radio signals and microtransmissions are called waves *not* merely by scientists, but in conventional usage, shows how pervasive the fallacious wave model of light, radio, and microtransmissions has become.

The logical error committed by post-Classical physicists has had consequences beyond the scientific field itself; the error has become entrenched in the general culture, the culture that relies so heavily on the physicists' claims to genuine understanding. This popular misuse of terminology might take decades to weed out through efforts of conscious persuasion by rational thinkers – all because previous post-Classical physicists had militantly refused to allow logic and philosophy to shape the formation of their theoretical models.

Chapter XVII
Rational Cosmology and Lasers

The Structure of the Laser Device

Essay CV

A laser device – named after an abbreviation for "light amplification by stimulated emission of radiation" – is a specific type of light source; it releases light of only one measurable magnitude and only in one direction. Instead of normal light's manifestation on all targets surrounding the light source, laser light appears as a concentrated beam, outside of which there is no light from the laser. Hence, laser light is *unidirectional*. The laser beam exhibits only one color; thus, laser light is said to be *monochromatic.*

Post-Classical physicists contend that the operation of a laser device can be explained only by viewing light as a simultaneous particle and wave. To refute this view, we will examine the operation of a simple laser device, a ruby laser. We will note where the post-Classical physicists invoke the erroneous duality. Finally, we will show that using the duality to explain the laser's function is unnecessary. The behavior of the laser device can be understood just as well when light is recognized as a relationship at a distance between source and target – the view I have developed thus far in *A Rational Cosmology*.

A ruby laser is constructed thus: A container, a ruby rod, is filled with a crystal called ruby, with molecular formula $CrAlO_3$. Physicist Dr. Jack Horgan describes ruby as "an aluminum oxide crystal in which some of the aluminum atoms have been replaced with chromium atoms." The chromium atoms absorb blue and green light and reflect only red light of magnitude 694.3 on the electromagnetic spectrum (or 694.3 "nanometers of wavelength", if the erroneous-duality-based unit of light is invoked).

Two mirrors are placed at both ends of the ruby rod. The rear mirror is a full mirror; it is capable of reflecting nearly all the light which light sources send at its surface. The front mirror, however, is partially silvered, allowing some light to be transmitted *through* the mirror, rather than altogether reflected off of it. Above the ruby rod is placed a flash tube – the original source of light.

That much is indisputable. Both rational cosmologists and today's physicists agree on the *factual details* of a laser's structure as well as its effects. It is in the theoretical interpretation of how those effects come about that the two thought systems differ. In subsequent essays, I shall show why it is not necessary to refer to "photons" or "waves" of light to consistently and usefully explain a laser's operation.

Explaining Laser Light Without the Particle-Wave Duality

Essay CVI

Both rational cosmology and contemporary physics can refer to and agree on the facts regarding how a laser light source is constructed and the kinds of visible effects it produces.

In the actual operation of the laser device, however, even the simplest explanations in line with post-Classical physics cannot avoid invoking non-existent "photons" and "waves of light". This is the explanation of a ruby laser's function from HowStuffWorks.com:

> "*The flash tube fires and injects light into the ruby rod. The light excites atoms in the ruby. Some of these atoms emit photons. Some of these photons run in a direction parallel to the ruby's axis, so they bounce back and forth off the mirrors. As they pass through the crystal, they stimulate emission in other atoms. Monochromatic, single-phase, columnated light leaves the ruby through the half-silvered mirror – laser light! ... The light released is* ***coherent****. It is "organized" – each photon moves in step with the others. This means that all of the photons have wave fronts that launch in unison*."

The "photon" element of this description is entirely superfluous to explaining the function of the device. How a single "photon" particle can also have a "wave front" – which would require a coordinated vibration of multiple particles – is also not clarified: conveniently so, because this is impossible and contradictory. I shall now demonstrate how the same events can be accounted for without invoking a particulate or wave view of light.

The flash tube is activated and transmits regular light to the ruby rod. The flash tube – the light source – interacts with the ruby rod – the target – via a direct relationship at a distance: light. No "particles" of light are passed between the two. The flash tube simply begins illuminating, and the ruby rod receives the illumination shortly afterward.

Because of the intrinsic properties of the ruby crystal, its chromium atoms become the ultimate targets of part of this relationship; they absorb light of magnitudes that correspond to blue or green coloration when reflected off appropriate entities. Light of these magnitudes ceases to participate in the further operation of the laser. The only light that the ruby crystals do *not* absorb is light of magnitude 694.3 – red light. The ruby crystals *reflect* this light, thus becoming its intermediate – not ultimate – targets.

The reflection of light stimulates the ruby crystals to emit additional light of their own. The post-Classical physicists say that light from the flash tube stimulates "photon release" by ruby crystals, but this is wholly unnecessary for explaining what happens. The received and reflected light simply triggers a process whereby the ruby crystals themselves become sources of additional light. This light is directed toward the mirrors, which subsequently reflect it toward the crystals, to stimulate further emission of light. Every act of reflection is a direct transmission of the light relationship from the mirror to the crystal – and vice versa. Light is never found in the empty space between the mirrors and crystals.

At some point in time, there is a sufficient quantity of light reflected by the rear mirror *in a single direction*: forward. The half-silvered mirror can only reflect so much light; it must transmit the rest. Light is transmitted *through* the half-silvered mirror in vast quantities, interacting with air molecules outside the laser device by imparting a vast quantity of the quality "luminosity" on each of them. (Luminosity is that quality, which enables a source entity to illuminate a target; it is the quality whose magnitudes are altered by the relationship of light.)

An Explanation for the Perceived Concentrated Beam of Laser Light

Essay CVII

Laser light in a ruby laser device is in fact an indirect interaction of the flash tube with the air molecules; light is transmitted from the flash tube (the ultimate source) to the air molecules (the ultimate targets) through a series of intermediaries – the crystals and the mirrors – reflection off of which ultimately orients the light in only one direction.

The laser light is seen as a concentrated "beam" because many trillions of air molecules in close proximity are rapidly illuminated. From a human perspective, the atoms and molecules are so close as to be seen as continuous – which explains the perceived continuity of the laser beam.

Every light source has a set amount of luminosity – the quality which enables it to illuminate. When it illuminates, it will always transfer the same overall amount of luminosity to accessible target entities – no matter whether these entities absorb, transmit, or reflect the light.

The laser is so built as to restrict its relationship of light to only certain target entities – i.e., the target entities directly in front of it, extending forward for some distance. The source still has the same amount of luminosity as a source that would expend that luminosity on target entities all around it. However, it can only use this luminosity in a certain direction. Hence, more of the luminosity is channeled in that direction, thus creating a more precise and intense "beam" of light – which is actually the sum of all the light relationships occurring between the source and the trillions of target atoms and molecules.

The light source's luminosity does not disappear into nowhere: the ruby crystals and the mirrors, acting as a system, simply *redirect* nearly all of it toward its ultimate targets. The luminosity lost to the crystals' absorption of the blue and green components of light is more than compensated for by the crystals' emission of additional red light.

A laser is a particular observation, and rational cosmology would not have been able to deduce it solely from ubiquitous observations of light. However, rational cosmology's explanation of light *is* compatible with all particular manifestations thereof. Thus, the particular observations of laser light do not contradict the view of light as a direct relationship at a distance between source and target; rather, they reaffirm it. Nowhere is the utilization of "photons" and "waves" necessary to explain how a laser functions; rather, these terms are needless impediments to understanding. Lasers work because they follow actual principles existing in reality, not imaginary models of light as particles or waves.

Chapter XVIII
Polarization of Light without the Wave Model

The Need to Explain Polarization of Light without Presupposing the Wave Model

Essay CVIII

In earlier essays of this series, I refuted the fashionable post-Classical view of light as a "particle/wave duality". Of course, it is unsatisfactory to simply prove a negative: to show that a given interpretation is *false.* Rather, one must replace the false understanding with a true one. I have done so thus far in *A Rational Cosmology,* classifying light as the direct relationship at a distance between a light source and its target.

This view of light as a relationship ought to be able to explain several particular phenomena which post-Classical physicists invoke to justify the "particle/wave duality". The "particle/wave duality" accounts for these phenomena, they allege, so it must be true.

Yet it is quite possible for a false model to incorporate and "explain" facts. It is possible to "explain" gravitation, for example, as the pulling of invisible green demons (or invisible "graviton" particles) on all objects. The mere ability to explain particulars does not automatically imply a theory's truth – especially if, like the "particle/wave duality" of light, the theory is riddled with contradictions. However, a true theory *will* be consistent with all the particulars of observation; reality brooks no contradictions.

In this series, I have already explained how rational cosmology's view of light is consistent with observations about radio signals and lasers. Now I shall examine its compatibility with another observation often invoked to justify the false duality.

Rational cosmology cannot derive the existence and nature of the polarization of light from ubiquitous observation alone. However, rational cosmology *is* reconcilable with the particular observations of polarization – which means the particulars can be explained without reference to the erroneous "particle/wave duality".

Unfortunately, because they are so deeply steeped in the wave model, contemporary physicists cannot even *define* polarization of light without reference to it. In every explanation of the phenomenon I have come across, this defect was readily manifest. The explanation that was supposed to *justify* the wave model of light actually *presupposed* the validity of that model.

Defining polarization in terms of waves of light and then claiming that polarization "proves" a wavelike nature to light is circular: it uses the wavelike nature of light to "prove" the wavelike nature of light. Furthermore, such descriptions are unlinked to empirical observation. Few of them address the question, "What do we directly *see* as a result of the polarization of light, which would be different had this phenomenon not occurred?"

The best description of the empirical phenomena for which the polarization of light accounts can be found on the website of The Physics Classroom. This site's description makes the same essential error as the others by presupposing the wave nature of light without explaining it – and then using it as a part of the description of the phenomenon of polarization.

Conveniently, the introductory paragraph to the description reads, "The nature of such electromagnetic waves is beyond the scope of The Physics Classroom." This conflicts with the very title of the description: "How Do We Know Light Behaves as a Wave?" We certainly cannot *know* that by *assuming* it from the beginning and stating that the nature of the assumption is too complex to justify in the text.

Nevertheless, The Physics Classroom is an excellent resource because it does devote much of its discussion to observable manifestations of the polarization of light, two of which we shall examine subsequently. I will show that the operation of Polaroid filters and the polarization of light by refraction off nonmetallic surfaces can be explained without reference to the wave model. Rather, the view of light as a direct relationship at a distance between source and target provides a far more adequate account of these phenomena.

An Explanation for the Operation of Polaroid Filters

Essay CIX

Here, I shall show how the polarization of light observed in Polaroid filters can be explained without referring to the wave model of light.

The Physics Classroom's description of polarization by Polaroid filters invokes the "wave nature" of light multiple times, but it still reveals much true information about the actual physical operation of the Polaroid filter. I cite crucial aspects of that description here.

> "*A Polaroid filter is able to polarize light because of the chemical composition of the filter material. The filter can be thought of as having long-chain molecules that are aligned within the filter in the same direction. During the fabrication of the filter, the long-chain molecules are stretched across the filter so that each molecule is (as much as possible) aligned in, say, the vertical direction. As unpolarized light strikes the filter, the portion of the waves vibrating in the vertical direction [is] absorbed by the filter. The general rule is that the electromagnetic vibrations which are in a direction parallel to the alignment of the molecules are absorbed."*
>
> "*The alignment of these molecules gives the filter a* ***polarization axis****. This polarization axis extends across the length of the filter and only allows vibrations of the electromagnetic wave that are parallel to the axis to pass through. Any vibrations which are perpendicular to the polarization axis are blocked by the filter. Thus, a Polaroid filter with its long-chain molecules aligned horizontally will have a polarization axis aligned vertically. Such a filter will block all horizontal vibrations and allow the vertical vibrations to be transmitted. On the other hand, a Polaroid filter with its long-chain molecules aligned vertically will have a polarization axis aligned horizontally; this filter will block all vertical vibrations and allow the horizontal vibrations to be transmitted*."

There are two components to the above description: an essential and a nonessential. The nonessential component is the assumption that light "vibrates" as a wave in directions parallel and perpendicular to the alignment of the long-chain molecules. The essential component is the description of the actual alignment of the long-chain molecules themselves. This alignment, not any fictitious "wave nature of light", is responsible for the Polaroid filter's operation and effects.

To understand how this is so, we first consider light as a relationship. Every relationship is the action of one entity on another to alter some of the other's qualities. By the fact of acting, the first entity also alters some of its own qualities.

Light is a relationship, so what qualities are altered during its course? We will call the quality which is affected by the relationship of light "luminosity". The target entity of the relationship *gains* luminosity by means of the light source's action on it. In order for the target entity to gain luminosity, the source must *expend* its own. Thus, the relationship of light can be thought to be a *transfer of luminosity between source and target.*

As with any quality, every entity has only finite amounts of luminosity. Furthermore, we know from ubiquitous observation that a regular light source can transfer this luminosity to a target entity in any direction from it. Transferring luminosity to a target in one direction does not inhibit the source's ability to transfer luminosity to targets in any other direction.

We can thus describe the source entity's luminosity as not only limited in overall magnitude, but limited in its magnitude *for every direction from the source entity.* Furthermore, the source's luminosity in one direction is expended *independently* of its luminosity in any other direction. If a target entity above the source absorbs all of the source's luminosity in the upward direction, this will have no effect on the source's luminosity in the downward direction; the source will still be able to illuminate other target entities below it.

Luminosity in one direction can be redirected elsewhere, but this is not done automatically by a regular light source. The light source must be specifically constructed for this purpose – as is a laser – or it must, in a given direction, encounter targets that reflect light elsewhere – as mirrors do.

What happens to a source's directional luminosity if it encounters targets? This luminosity is expended on the targets, in proportion to the targets' number and density. I wrote in Essay XLV: "Light as a Direct Relationship Between the Source and the Target":

> "Light does not require continuity of particles in order to propagate; it can overcome a vacuum – i.e., the absence of a medium. On the contrary, it seems that, the more dense the medium, the less receptive it is to light. Light can propagate through gaseous media, and some liquids (such as water), but not through most solids."

If there is some large concentration of particles in the way between the light source and the intended target, then, naturally, a source's luminosity will be partially expended on these particles! In the directions where there are no such particles, the source's luminosity will *not* be spent, however.

In a Polaroid filter, the long-chain molecules are this concentration of particles, and the source entity must exhibit the relationship of light with them. Because the long-chain molecules are solid and do not have surfaces which allow for reflection of light, they will absorb that part of the light which is transmitted directly at them. (The Physics Classroom describes this as the light "parallel" to the long-chain molecules.) The source's luminosity in that direction will be entirely expended, allowing for no further relationship of light in that direction.

On the contrary, where there are no long-chain molecules and thus no intervening object between the source and the intended target, the relationship of light will propagate onward to the intended target. This is the case with light that The Physics Classroom calls "perpendicular" to the long-chain molecules.

I describe this situation as follows: there is no intervening object between the source and the target, so, naturally, the light will reach the target. The source has all of its original luminosity in

that direction to expend on that target. On the contrary, light that had the intervening long-chain molecules as its target will naturally not reach the targets beyond the filter.

To summarize, every light source not only has limited luminosity, but limited luminosity *in every particular direction*. In the direction parallel to the long-chain molecules of the filter, the source's luminosity is expended on interaction with the molecules. In the direction perpendicular to the molecules, there is no obstruction, so this luminosity is not expended; rather, the source has enough luminosity to interact with the intended target.

The so-called "polarization axis" of the filter is simply the sum of the directions where light from the source entity does not encounter the filter's molecules as targets. Rather, light in those directions altogether bypasses the filter. In those directions, there is no obstruction between the source and the target, so a direct relationship between source and target can occur.

This explanation for the operation of Polaroid filters does not invoke fictitious "vibrations" of light, which are inconsistent with ubiquitous observation. Rather, it depends only on undoubtedly known physical properties of the filter and an understanding – supported by ubiquitous observation – of how luminosity is transferred. Hence, ubiquitous and particular observation are reconciled, without the erroneous "duality of light" to sever them apart.

An Explanation for Polarization of Light by Reflection Off of Nonmetallic Surfaces

Essay CX

This essay will explain, without reference to the view of light as a wave, the phenomenon of light's polarization by reflection off of nonmetallic surfaces; it will then proceed to give a logically and empirically consistent definition of the polarization phenomenon itself.

The Physics Classroom describes a frequent manifestation of the polarization of light thus:

> *"Unpolarized light can also undergo polarization by reflection off of nonmetallic surfaces. The extent to which polarization occurs is dependent upon the angle at which the light approaches the surface and upon the material which the surface is made of. Metallic surfaces reflect light with a variety of vibrational directions; such reflected light is unpolarized. However, nonmetallic surfaces such as asphalt roadways, snow fields, and water reflect light such that there is a large concentration of vibrations in a plane parallel to the reflecting surface. A person viewing objects by means of light reflected off of nonmetallic surfaces will often perceive a glare if the extent of polarization is large."*

Again, assuming that light "vibrates" is unnecessary for describing this phenomenon. Rather, this type of polarization can be explained by analyzing the transfer of the source's luminosity in relevant directions.

It is known that nonmetallic surfaces are far better able to absorb light than to reflect it, due to the microscopically rough nature of said surfaces. The natures of *both* the source and target affect the relationship of light – a truth I have always maintained.

Let us presume, as the scenario requires, that light is transmitted to a nonmetallic surface from a source at an angle to that surface. The direction in which the source's luminosity is expended is the direction of that angle. This direction (not the light itself) has a parallel and a perpendicular component to it with respect to the target surface.

Light aimed in the perpendicular component of that direction gets absorbed by the surface, since the light is transmitted directly *toward* the surface. Meanwhile, *only* the light aimed in the parallel component of that direction gets reflected off the surface. Being parallel to the target surface, this light cannot be transmitted toward the surface; the most the surface can do is redirect its transmission to another target entity. Because the target surface cannot receive this light, and because all light must have a target, the light is reflected at an angle to some other target. Yet, the only light that is reflected is the "polarized" light, which had not been absorbed by the surface.

Targets with metallic surfaces, on the contrary, have a tendency to reflect *all* the light that is transmitted to them, irrespective of the direction of the surface from the source. Thus, the light they reflect is "unpolarized", since the source's luminosity was not expended in any direction.

I will now define polarization in terms admissible by rational cosmology.

Polarization of light is the result of the light source's *limited expenditure of luminosity* in only those directions where an intervening target is found between the source and the original target. All light in the direction of the intervening target is absorbed by that target, whereas light which is not directed toward the intervening target is passed to the original target in the form of polarized light – either through direct transmission or through reflection.

Any assumption that light must "vibrate" in order to be polarized is entirely superfluous. It certainly does not have to "vibrate" to be blocked by an intervening target in some directions and not blocked in others – which is the essence of polarization. Polarization does not "prove" the wave model of light, either, since another model – the relationship model of rational cosmology – can account for it just as well, while not contradicting ubiquitous observation.

Chapter XIX
Transmission Without Travel: The Behavior of Light

A Refutation of the "Universality of Matter Transfer" Fallacy

Essay CXI

Here, I shall expand on my view of how light is transferred between its source and its target. Conceiving of light as a direct relationship at a distance between source and target, I claim that light does not "travel" between the two, as a particle might. Rather, light appears on the target *directly* from the source, without ever being present in any intermediate locations where no other entity exists. I explain this in Essay XLV: "Light as a Direct Relationship Between Source and Target":

> "Since light is not a particle, it cannot simply be *sent* from one entity to another and *then* affect the target entity. There is no 'sending' of light, but rather the relationship is *directly* between the source entity and target entity, without any entities that must necessarily be intermittent for the relationship to occur. Light is the name for the *interaction at a distance* which the source and target entities undergo. In that sense, there is quite a contrast between a wave relationship, such as sound, which requires the presence of billions of periodically vibrating molecules between the source and the perceiver, and light, which requires *only* the source and target entities. Though, like a wave, light is a relationship, in certain critical fundamental aspects it is as far removed from waves as relationships can get."

This view is grounded in ubiquitous observation – which has never encountered light except as manifested by some source or target entity. It is not a widely accepted view, however. What prevents its understanding by post-Classical physicists and the public at large is a commonplace fallacy: the idea that all relationships of process must involve some transfer of matter from one entity to another.

A corollary to this fallacy is that all relationships of process are also relationships of *contact* – that no two entities can have a relationship of any sort unless some *third* material entity is transferred between them by moving spatially from the entity that originates it to the entity that receives it.

Falling prey to this fallacy, many of today's physicists think that light can only be manifested if some particle or entity is transferred through space between the source and the target. I shall shatter this misconception here and show that it is quite conceivable for light to occur without *any* transfer of matter. Furthermore, the direct transfer of light without any contact between

source and target – and without any intermediate "light carriers" – is the only view of light consistent with logic and ubiquitous observation.

The "Universality of Matter Transfer" Fallacy

Post-Classical physicists often commit a fallacy which results in their invocation of a myriad of fictitious particles, including the "photon" particle of light. This fallacy is the result of an attempt to explain all existent processes by means of a single quality: matter.

Under this view, no process can occur except by the transfer of matter from one entity to another; every process requires that the fundamental "stuff" of an entity be altered in some manner. Since matter cannot exist except as possessed by entities – a view that most people grasp implicitly if not explicitly – advocates of the fallacy claim that no relationship can occur without the originating entity either directly touching the entity it affects or sending some *intermediate entity* to it. The idea of the universality of matter transfer leads to the presumption that all relationships are ultimately *relationships of contact.*

This idea is false, and ubiquitous observation can demonstrate its falsehood. One can observe relationships of force, such as gravitation and magnetism, which do not require the continuity of two entities' boundaries, or the transfer of some intermediate material *entity* between them.

These relationships occur directly and at a distance, without at all altering the intermediate space between the two participant objects. We are all constantly affected by the Sun's gravitation, for example, but this does not mean that the Sun transfers any of its mass to us – or that we, who also exert a gravitational force on the Sun, transfer any of our mass to it. If such a case were true, we would be quite rapidly wasted away into nothing by the mere fact of our presence in the Solar System!

What do distance forces between two entities do? They accelerate both entities, altering their *velocities.* The entities' amounts of the quality "matter" remain the same as they were before the interaction. Acceleration is the change in velocity with respect to time – or, in terms of the fundamental qualities of entities, the change of "the change of distance with respect to time" with respect to time.

Acceleration alone nowhere concerns the change in an entity's amount of matter. The magnitude of an entity's acceleration due to a force is *dependent* on the amount of matter an entity has (the more material it is, the less it will accelerate), but no entity in the force interaction *gains* or *loses* matter to the other entity. An entity's acceleration might depend on an entity's mass, but this is a one-way dependency. An entity's mass does not depend on its acceleration.

Force is a relationship that affects entities' acceleration alone – which means it affects qualities other than their matter, which means that the relationship of force does not require an alteration in an entity's material qualities. Of course, contact forces do exist, but these forces also do not transfer matter to the entities they affect. They only "push" or "pull" those entities, altering their velocities but nothing else. (Inelastic collisions, which *do* involve matter transfer, are a different subject entirely. Forces are involved in those collisions, but the transfer of matter only

accompanies the forces. It is not in itself a part of the forces.) However, forces are not required to be contact forces, since they are not a transfer of the quality "matter".

In the face of contrary evidence, dogged adherents to the "universality of matter transfer" fallacy still maintain that all interactions are ultimately contact-based. When confronted with gravitation or magnetism, they invent fictitious particles, such as "gravitons", which they claim "convey" forces to their target entities. I thoroughly demonstrated the logical impossibility of this scenario in Essay LXII: "The Non-Existence of Gravitons or Other 'Force Particles.'"

Forces are only possible among entities with mass. Gravitons, as "immaterial force carriers", are self-contradictory on many levels, since all entities must be material, and all entities that can exert forces must also be material. Furthermore, the idea of intermediate particles such as "gravitons" is entirely superfluous for describing a relationship that can be much more simply accounted for by the direct interaction of two entities at a distance.

Why Illumination Does Not Require the Travel of Particles

Essay CXII

This essay shall endeavor to show that the relationship of light is not made manifest through the travel of anything, because no matter is transferred from one entity to another during the process of illumination.

Transfer of luminosity is not transfer of matter.

Light is not a force – as I have demonstrated in Essay CIII: "Light Results in Illumination, Not Acceleration" – since all forces cause their targets to accelerate, whereas light *qua* light does not. However, light, too, is a relationship that does not in itself affect the participant entities' material qualities.

No entity becomes more or less massive just by being illuminated. If the contrary were the case, the Earth would have an enormous coating of mass added onto it from the 4.6 billion years it was continuously illuminated by the Sun. Thus, the relationship of light affects not the participant entities' matter, but some *other* of their qualities. This quality can be called *luminosity.*

Since luminosity is not matter, and it can be transferred independently of matter, light does not require the transfer of matter to occur. Thus, light does not require intermediate entities to "carry" it between the source and the target. This means that luminosity can be transferred at a distance, without at all altering the affected entities' amounts of matter or the arrangement of their constituent particles.

Travel is only required for transfers of matter.

Light does not travel through space and does not manifest itself in any intermediate region between its source and some target entity (which includes targets other than the intended or anticipated one).

Wherever there is an entity sufficiently proximate to the light source and not blocked from it by others, it will be illuminated. Wherever there is no entity, there will be no light. Light is a transfer of luminosity, which is a quality. Qualities are qualities of entities, and no "absence of entities" can ever have qualities. Thus, wherever there are no entities, there is no luminosity and hence no light.

The above implies that light cannot "travel" through space. Only entities can travel, and all entities are material. Any transfer of qualities not including matter cannot have entities involved in it – and thus cannot involve "travel."

It is thus not only possible for light *not* to involve intermediate entities: it is impossible for light *to* involve such entities. Only distance relationships where matter is transferred from the source to the target can have intermediate entities traveling between the source and target to transfer this matter. Luminosity alone cannot be transferred by this means.

How Light is Transmitted without Traveling

Essay CXIII

The knowledge that the relationship of light takes time to initiate often misleads many to believe that, during this time, light must necessarily *travel* from the source to the target. This is a common *non sequitur.* On the now-defunct Autonomist Forum, Reginald Firehammer asked me: "*My question is, when a light source (say a laser burst) occurs, there is some time before that light 'reaches' its destination. In the time between when light is (transmitted?) and the time when it is (received?) what is going on?*"

This question can indeed be readily answered using the insights of rational cosmology. In the time between light's transmission and its reception, the source is acting on the target in order to make the relationship of light happen. No action is instantaneous; all action takes time to perform. The source's action on the target takes time to perform, as well; the farther away the target is, the more time is needed before the consequences of the action manifest themselves.

However, this should not be taken to imply that light can at all "travel". The source acts *directly* on the target at a distance, and the source directly but gradually alters the target's quality of luminosity – similar to the way entities constituting a force-pair gradually alter each other's spatial qualities.

During the time between light's transmission and reception, the source is acting on the target in that way, which is necessary for the target to be illuminated thereafter. While no light appears on the target, the source is *preparin*g to carry out the relationship of illumination. When this preparation stage, needed to carry out the relationship, is over, the relationship manifests itself.

There is no "in-between" stage for light; light cannot be found anywhere except the source or the target. I wrote in Essay XLIX: "Measuring Light's Transmission":

> "If there is no entity $1.5*10^8$ meters away from a source, there will be no light there, even if a half-second had passed from the moment of emission of light. As earlier explained, the very occurrence of 'beams' of light in particulate media is explained by the effects of the source on the many closely grouped molecules comprising the media."

Even if it is true – as Max Planck suggested – that light is transferred in discrete quantities, it takes time to transfer each such quantity. It might be that this quantity of luminosity transferred is the "threshold" required for the target entity to begin manifesting illumination. Prior to reaching that threshold, the target entity simply does not have enough luminosity to manifest visible signs of light.

Seeing Light

Essay CXIV

What are the conditions under which a human observer can see light? How can an understanding of these conditions be incorporated into rational cosmology's view of light as a direct relationship between its source and its target? This essay shall endeavor to answer such questions.

A human observer can only see light if he, too, is a direct or indirect target of the relationship. If he sees the light source, he is directly targeted by it. If he sees a target of the relationship, this is because the target has also redirected part of the light to the observer's eyes.

A common misconception has arisen since at least the time of Albert Einstein, which holds that light must be something *other* than a relationship solely between source and target, because we can at times see light at its source before we see it at its target – which is taken to imply that light is a "particle" that "travels" to us faster than it "travels" to the more distant target.

This is false view. The only way we would be able to see light from some source before it was manifested on a target far away is if *we* were targets closer to the source than the original target. If no such targets existed, no light would exist until the source reached the original target.

Because we are closer to the source than the original target, it takes less time for the relationship of light to fully manifest itself, since it is more time-consuming for a source to directly act on a farther entity than on a nearer one. Thus, *we* are illuminated before the farther target and can see the source.

But this does not mean that light exists anywhere *but* on the source and targets. Human designation does not necessarily equal reality. The fact that we have designated some farther entity a "target" of the relationship of light does not mean that it is the *only* target.

If we do not *yet* see light manifest on that target, this does not mean that the light can exist independently of a target. It simply exists with respect to some *other closer target*, which happens to be the observer. Some targets – by virtue of their proximity to the light source – are easier for the source to directly act upon than others.

Thus, our ability to see light at a source before seeing it at some more remote target from the source than ourselves is not a refutation of the relationship view of light; it is quite consistent with such a view, once we come to consider ourselves as targets of the light relationship as well.

The Impossibility of Seeing No-Longer-Existing Light Sources

Essay CXV

The false view that light can "travel" has led to the fallacy that a source can transmit light and become destroyed – while light still reaches the target. This fallacy is used to invoke the possibility of "seeing" stars far away that have since been destroyed, since it takes multiple millions of years for light from them to be transmitted to the Earth.

Thus, advocates of this view claim, the fact that the transmission of light takes time enables us to "look into the past" and see the source as it had been when it *began* to transmit light – while the source might look entirely different or altogether not exist at the time when we perceive its past state.

Reginald Firehammer presupposed this fallacious view when asking me the following question on the now-defunct Autonomist Forum:

> "*Consider a laser burst of light from the earth to the moon. The laser could transmit the light, and the transmitter destroyed before the light is 'seen' on the moon. If the laser transmitter is destroyed before the light reaches the moon, something must be that is the thing the light being seen is the 'relationship' to if your theory is correct. You would say the light is the relationship between the transmitter and receiver, but if there is no transmitter....?*"

To respond, I claim that light cannot *ever* be "seen" if its source is destroyed before the transfer of luminosity is fully effective. Every action takes time to perform, and illumination is no exception. The light source does not begin to act upon the target only when light "reaches" the target; that would imply the fallacy that light travels.

The light source begins acting upon the target *immediately upon initiating the transmission of light.* Because it takes time for the consequences of every action to manifest themselves, the visible consequences of illumination are not instantaneous. However, *continuous direct activity* by the light source upon the target *is* required for illumination to *ever* occur. If the light source ever ceases to be, it will cease to transfer luminosity to the target, and the target will never exceed the luminosity threshold necessary for it to visibly manifest light.

If there is no light source, it follows that the relationship of light cannot occur. If the source is destroyed, the relationship ceases upon the source's destruction. The only way that we can observe light is if it emanates from a source that *presently exists*. Thus, if it takes a second for light to be transmitted from the source to the target, the source must continue to exist *after* that second elapses, or else the relationship would instantly cease.

If the light is the action of a source on a target, no action can occur when the acting entity no longer exists, and the only entities that can act are those that presently exist. The human senses can also only perceive presently existent entities. If the human senses are fully equipped to know reality, they must be fully equipped to know the reality currently before them, and not some eclectic mix of past and present.

Two Stages of the Relationship of Light

To summarize, rational cosmology requires two stages for the relationship of light, neither of them involving "travel" or the transfer of matter:

1) **The transmission step**: No illumination occurs during this step, but the source is directly acting on the target to prepare it for illumination. Luminosity is acquired by the target, gradually approaching the threshold required for illumination.

2) **The illumination step**: The visual manifestation of the relationship, after the target has exceeded its luminosity threshold.

Both the source and the target must be present for each step.

Appendix

Issues Regarding Different Definitions of the Universe

Essay CXVI

This essay addresses the possibility of different definitions of the term "universe" from the definition I have previously given of the universe as "everything that exists." Such differences in definition, it will be seen, do not change the fact that the universe can be neither created nor destroyed.

In response to my essays on the universe in *A Rational Cosmology*, I received a series of interesting and thought-provoking remarks from Mr. Leonid Fainberg. Mr. Fainberg wrote:

> "*According to your description, by 'universe' we usually mean the physical world, the total sum of entities. Existence is the subject-matter of metaphysics. Universe is the subject-matter of Cosmology and physics. The Crab Nebula is part of the universe (and existence) but it would be awkward and not very appropriate to describe philosophy or*

individual rights as part of the universe. Your definition of the universe as a collective designation of all entities has another corollary – this concept describes only known entities. Existence, however, describes any entity, already discovered or waiting to be discovered. Existence, therefore, is a much broader concept than the universe. The implication of this conclusion is that one cannot always ascribe properties of existence to the universe. Existence exists, and this is an axiom. But the existence of the universe as a collection of known entities is not axiomatic. (To talk about the universe as a collection of unknown entities would be contradictory – one cannot discuss an unknown universe). We have no knowledge of the whole universe, not even a significant part of it. For example, we have only recently discovered that 95% of the universe's mass is made up of dark matter. So in actual fact we only know about 5% of what constitutes the universe."

Although one does not typically speak of "the universe" as containing individual rights or philosophy, I claim that if "the universe" were to cease existing, philosophy, individual rights, and all other aspects of "existence" would cease existing as well – thus leading to an impossible contradiction of the axiom of existence.

All qualities are ultimately qualities of physical entities, and all relationships are ultimately relationships between and among physical entities. Individual rights, for instance, are qualities of individual human beings. Philosophy is ultimately the relationship of human beings to the natural world, their own minds and bodies, and other human beings in such a way that the humans engaged in this relationship seek to discover proper ways for interpreting the fundamentals of the natural world and the proper ways for them to act.

It follows, then, that if all entities of a given sort disappear, all qualities and relationships pertaining to them would disappear also. If humans were to all disappear, there would no longer be any individual rights or philosophy – provided that no other rational life form exists. So, if all physical entities were to disappear, all qualities and relationships would disappear as well – and thus all of existence would cease to exist, which is a violation of the axiom both Mr. Fainberg and I recognize.

The definition of "universe" I use is "the *sum* of all entities that exist", which is, of course, identical to "the sum of all *physical* entities that exist". This encompasses all entities that exist, whether or not they are currently known to us.

What Mr. Fainberg says regarding the impossibility of discussing an unknown universe is true – provided that it is entirely unknown. But *some entities* in this universe are known to us, and on the basis of this knowledge, we can make generalizations about the others which we can expect to hold true if and when we discover those previously unknown entities. For instance, while many of the properties of dark matter might be a mystery to us, we can be certain that dark matter has identifiable mass, volume, and spatial extension.

But the definition of "universe" which Mr. Fainberg proposed is a different definition: "the collection of *known* entities", which is a much narrower subset of the universe as I define it. Different conclusions will follow from this definition, I grant. For sake of clarity, let us use the following terminology to distinguish these two different definitions:

Universe$_a$ = the collection of *all* entities that exist.

Universe$_b$ = the collection of *known* entities (we shall assume that this is the collection of *all* the entities known to *any* human being(s), living either currently or in the past).

It follows then that universe$_a$ cannot be destroyed, for that would violate the axiom of existence. It is conceivable, however, that universe$_b$ might someday cease to exist, in the sense that all entities that have been known to any humans living either currently or in the past might someday cease to exist. However, this cessation will not occur at a single time – as some of those entities might cease to exist tomorrow, and others might cease to exist in a trillion years.

Furthermore – though it is possible – it is still extremely *difficult* for universe$_b$ to ever cease to exist, because the collection of *known* entities keeps expanding by virtue of the expansion of human knowledge. Every time a human being discovers a new entity, that entity becomes part of universe$_b$. Every currently unknown entity is potentially *knowable;* that is, it is potentially *identifiable,* since it has some specific identity. Thus, as human knowledge increases, the set of entities encompassed by universe$_b$ will approach the set of entities encompassed by universe$_a$, which will make it increasingly less likely for universe$_b$ to ever cease to exist.

Moreover, as universe$_b$ depends on the state of human knowledge at given time, it is still not valid for physicists to make generalizations concerning "its" ultimate future, since the future of universe$_b$ is the collection of the distinct futures of the entities it encompasses. As new entities are added to the set, the collection of these futures will change as well. Since these new entities are currently unknown, their futures cannot be currently known, either, so it makes no sense for physicists to *currently* make generalizations about specific futures that are not currently known.

Thus, the province of physicists is neither to describe the future of universe$_a$ nor that of universe$_b$, but rather to study *(i)* the mechanical laws governing entities and *(ii)* the peculiar properties of certain *specific entities* which are encompassed by universe$_b$. Those entities include atoms and planets – objects about which physics might tell us more than our everyday experiences alone would.

When it comes to specific planets and stars, it is entirely within the province of physicists to try and predict what will happen to those entities – and it is entirely conceivable that any specific planet or star might someday cease to exist (and even that a large but finite collection of planets and stars such as a galaxy might someday cease to exist). But at that point the physicist would be describing the futures of specific planets, stars, and galaxies, not "the universe" in either sense.

The Possibility of an Absolute Definition of Motion

Essay CXVII

This essay shall endeavor to show that in a universe with more than one entity and the presence of some observer, it is possible to define motion in absolute terms by holding a reference point mentally fixed.

In his remarks on the ideas in *A Rational Cosmology*, Mr. Fainberg writes the following about motion:

> "*Space has been defined in* A Rational Cosmology *as a relationship between two or more distinct entities. Space itself is not an entity and therefore cannot be the point of reference. This definition has an important corollary: contrary to Aristotle, there is no such a thing as absolute rest. In the hypothetical universe comprised of only one object, it would be impossible to determine if this object is moving or not. In the universe comprised of two objects, it would be impossible to determine which one of them is moving. The same principle applies to any number of objects. Every entity is resting or moving only relatively to another entity. Therefore, velocities of moving objects are relative to the object of reference, which can be voluntarily chosen*."

There is some truth in what Mr. Fainberg says here, and I would like to explain my understanding of it in the context of my views of space and of motion.

In a hypothetical one-object universe with no intelligent observer of that object, there is indeed no distinction between rest and motion and no way to determine whether that object moved or not – provided, of course, that the object has no component parts that move relative to each other.

However, if we, as observers, try to model the behavior of that object, we can do so via a three-dimensional Cartesian Coordinate System. We can designate some point on the object at time t as (0, 0, 0) on our coordinate system and hold that point mentally fixed. If the object departs from that point at some other time (t+1), we can measure the object's motion relative to (0, 0, 0) during one unit of time.

Of course, we as observers would not exist in a one-object universe by definition – since an observer would be a second entity introduced into the universe. It is true, then, that in order to determine whether any entity moves, some second entity is required (such as an intelligent observer, a measuring tool, or even an imagined point of reference which an intelligent observer needs to think of).

In a two-entity universe, however, it may well be possible to determine whether an object is at rest or in motion. One entity simply needs to be the observer himself; the observer notes the other entity's position at time t and calls it (0, 0, 0). He remembers where (0, 0, 0) is and would be able to identify it even if no entity was there any longer. He can then compare the other entity's subsequent positions with its position at time t and thus determine whether or not it moved.

This determination, of course, depends on the selection of an arbitrary fixed reference point – but any such point is as good as any other for finding *that* absolute motion occurs. For example, the observer himself might be moving away from (0, 0, 0) while he observes the other entity doing the same. In this two-object universe, it might be possible to say that *both* entities moved and *how much* they moved – because motion is calculated relative to a fixed and imagined reference point.

Since in our universe there exist more than two entities and we as observers also exist, it is possible to furnish an absolute definition of motion applicable to the world in which we live.

Entities and Spatial Continuity: Why "the Universe" is Not a "Thing"

Essay CXVIII

A Rational Cosmology identifies three – and only three – fundamental, mutually exclusive types of existents: entities, qualities, and relationships.

Entities are things which exist. A table, chair, bacterium, planet, human being, etc., are all entities.

Qualities are attributes of entities, inseparable from entities themselves. Matter, volume, length, width, height, time, luminosity, etc., are all qualities. All qualities must belong to specific entities and cannot exist independently of some specific entities.

Relationships are interactions among different entities that affect the qualities of those entities. Distance of separation, motion, acceleration, force, light, life, consciousness, volition, value, ideas, etc., are all relationships. No relationships can exist apart from entities that relate and qualities which are affected in the relationships' course. Significant to note is that classifying an existent as a relationship does *not* imply that this existent's truth is somehow "relative". Relationships' truth is as absolute as the truth of entities and qualities: motion, life, and value exist as certainly and as irrefutably as rocks, furniture, and people.

This essay will focus on defining the first type of existent – the entity – in an attempt to avoid mistaken classifications of pseudo-concepts or reified concepts as entities.

Origins of the Task Before Us

The trigger for this essay's creation was an e-mail sent to me by a reader of *A Rational Cosmology*. He referred to Chapter II, where I endeavor to prove that the universe is not an entity. The following is a citation from the *original* First Edition of *A Rational Cosmology*, which was revised subsequent to my correspondence with this reader:

> "The term ‘universe’ does not denote an *entity*, however. It is the *sum* of all entities that exist. It is *not* a ‘whole’ in the sense that a planet, a star, or even a galaxy is a ‘whole.’ As a matter of fact, it would be absurd to state that Chicago, Quasimodo, a telescope, and a hippopotamus compose some inextricably whole entity. It follows that it would be even more absurd to state that Chicago, Quasimodo, a telescope, a hippopotamus, *and everything else* compose some inextricably whole entity."

Arguing that my definition of "entity" is ambiguous, the reader proceeded to inquire whether I intended to argue that the universe is not a homogeneous entity or not a heterogeneous entity – a

distinction I make later in Chapter II. A homogeneous entity is an entity inseparable into component parts: it exhibits uniform distribution of every quality possessed, its parts cannot be completely separated from one another, and it is unable to act to alter itself. I write that, though it is conceivable that such entities exist as the basic "building blocks" of more complex entities, no homogeneous entity has ever been definitively known to exist. From this, the reader inferred that the universe cannot be a homogeneous entity.

The more difficult issue arose regarding whether the universe could be a heterogeneous entity. A heterogeneous entity is the sum of more basic constituent entities – related to one another in a certain manner. For example, a human being is the sum of numerous component entities; the human organism can be viewed as a combination of atomic entities, cellular entities, tissues, organs, or whole regions of the body. The reader did not see a distinction between calling the combination of body parts an "organism" and calling a combination of existent entities "the universe" – considered as an entity in its own right. He asked, "If the universe cannot be a whole insomuch as it is constituted by a Chicago, Quasimodo, a telescope, and a hippopotamus, how, then can we be entities as a bone, a brain, an arm, and a foot?"

Yet one of these combinations – the body – is indeed an entity in its own right, while the other – the universe – is no entity at all. It is rather purely a human construct – a word used for verbal shorthand instead of listing all the entities that exist. When one wishes to make a generalization about qualities or relationships that all existing entities exhibit, it is much more convenient for one to speak about "universal qualities" than about "qualities of Chicago, Quasimodo, this telescope, that hippopotamus, etc." Yet this is the whole function the concept "universe" serves; it is not an entity and not even an *existent* in its own right (apart from the immensely many separate existents that are said to comprise it).

By defining what an entity is – what qualities and relationships every existing entity must exhibit – I shall demonstrate why precisely "the universe" must be excluded from this category. Along the way, I shall make several important revisions to the proper definition of a heterogeneous entity – as the description of such entities given in *A Rational Cosmology* is too broad. Narrowing it is necessary to achieve logical consistency and adherence to reality.

Spatial Continuity as a Ubiquitous Quality of Entities

Chapter III of *A Rational Cosmology* described some ubiquitous qualities of entities: qualities that all entities must possess by the very nature of their status as entities. These include matter, volume, length, width, and height. Chapter IV describes another such ubiquitous quality: time. I will not add to the discussion of these qualities here, except to say that the aforementioned writings provide proof that asserting an entity's existence in these qualities' absence is self-contradictory. Instead, I will supplement the list of ubiquitous qualities of entities with one more critical quality.

Spatial Continuity: Every entity – homogeneous or heterogeneous – must have continuity among all of its parts. The test for spatial continuity is this: is it conceivable for one to trace a path from any point on the entity to any other point without *any part* of that path entering a region of "space-as-absence" – i.e., a region where the entity does not exist? If such a path is

conceivable – no matter whether one' s current level of technological advancement actually permits one to trace it – the entity is continuous and is affirmed in this ubiquitous quality.

In real life, it is quite easy to ascertain an entity's continuity by actually observing the entity and seeing that every one of its parts is linked spatially. One does this by tracing the continuous path along the entity *mentally* and recognizing that – were one to actually, physically trace such a path – it would fail to be anything *but* perfectly continuous.

While many real objects are spatially discontinuous *from one another,* it is inconceivable that a *single object* with non-continuous parts could exist. A non-continuous entity is a contradiction in terms: it is disconnected spatially from itself.

Consider what it means for an entity to have spatial boundaries. A boundary is a set of points on an entity which describe the outermost extent of the entity. The fact that a given entity has a boundary implies that no part of that entity exists outside that boundary. Since every individual entity must have *finite* measurements of every spatial quality, every individual entity must be enclosed by a boundary; otherwise, the entity would be infinite – a logical impossibility, as I show in Chapter IX. If the entity is spatially continuous, then it is possible to trace a path from any point on the entity' s boundary to any other point. Thus, the entity's boundary is *unitary;* there is only one boundary, and it marks the entity's outermost extent. No part of that entity can exist beyond the unitary boundary that surrounds the entire entity.

Let us now, for the sake of argument, assume some entity which is not spatially continuous. This means that it is impossible to trace a path from any one point on the entity's boundary to any other point. Thus, the entity's boundary is *non-unitary.* This hypothetical entity would need to have multiple boundaries that are not spatially connected! However, since a boundary is a set of points beyond which *no part of the entity exists,* the scenario of a non-continuous entity is a contradiction in terms. If there are parts of an entity entirely spatially detached from other parts, they are hence *beyond* the boundaries of the other parts, since those boundaries do not surround them. These parts – being beyond the entity' s boundaries – are thus beyond the entity's outermost extent. They are beyond that, which no parts of the entity can be beyond! Clearly, this is an assertion that A does not equal A. We have proved that the very idea of a spatially non-continuous entity fatally undermines itself. The only way to resolve this dilemma is to concede that the parts beyond the entity's boundaries are discrete entities in themselves and not part of the fictitious disjointed entity assumed at the beginning.

The requirement of spatial continuity as a ubiquitous quality of entities implies that certain revisions must be made to my statements in Chapter II of the First Edition of *A Rational Cosmology.* For example, a galaxy can no longer be considered an entity, since the stars and planets composing it are not spatially continuous with one another; much "space-as-absence" separates them in all directions. The galaxy is rather a *proximate cluster* of *discrete* entities – stars and planets – that relate to one another in systematic, interesting, and noteworthy ways. Cities, however, can still be viewed as entities – provided that one includes all the buildings and the ground they stand on in the designation and provided that the requirement of spatial continuity is met. Chicago can still be viewed as an entity – minus the people living there – if

one can trace a path between any two points on any two buildings and not once leave the city's boundary.

Furthermore, I no longer maintain my prior assertion (in the First Edition of *A Rational Cosmology*) that it is possible for a heterogeneous entity to have disjointed parts – since this would preclude its entity status. The moment one of an entity's parts is severed from it and rendered discontinuous to it, the entity splits in two. Even an atom falling off a human being implies that one heterogeneous entity has become two discrete heterogeneous entities: the remaining human and the atom.

An even more radical implication of the discovery that spatial continuity is necessary for entities is a rejection of the common cliché of post-Classical physicists that atoms are "mostly empty space". It simply cannot be that spatially continuous macro-entities are made of spatially discontinuous micro-entities. Rather, it must follow that every atom is spatially continuous with itself, and that every atom in every larger heterogeneous entity is spatially continuous with every other atom in that entity. This realization is categorically not at odds with empirical knowledge; atoms have never been observed directly, and thus the assumption that they are "mostly empty space" is just a contingent "operational hypothesis" that could be rendered mathematically consistent with some other data. Yet some better understanding is needed to reconcile atomic theory with the logical truth that every entity must be spatially continuous with itself. It is clear that primitive models of spheres orbiting around other spheres do not accurately describe atomic structure. Perhaps if scientists abandoned conceiving of protons, neutrons, and electrons as tiny, round balls, they would be able to explain both atoms' internal continuity and their ability to be continuous with one another in large combinations.

The universe is not spatially continuous. Thus, the universe is not an entity.

If the universe were a heterogeneous entity, it would fail the test of spatial continuity. Such an entity would be comprised of multiple parts entirely spatially disconnected from one another. Even two planets are separated from one another by millions of kilometers where no entities exist. It would thus be impossible to trace a path (in reality, using a material surface) from one planet or star to another planet or star. Hence, it is inappropriate and logically contradictory to classify the listing or summation of these planets and stars as a single entity-in-itself. "The universe" is only a compendium, created by the human mind, of the various discrete entities that exist. The term itself is mere summary notation, not some over-arching super-entity.

Hence, we can see how a spatially continuous combination of multiple distinct entities – such as a human body or even a city (minus the inhabitants) – can be called a single heterogeneous entity-in-itself, whereas a spatially discontinuous total of all discrete entities that exist -- the universe – cannot be anything more than just a convenient collective designation of no independent ontological existence. My reader's dilemma has been resolved and rational cosmology improved by the explicit analysis of spatial continuity's necessity as a ubiquitous quality of every entity.

What is an Entity: A Topological Definition

Essay CXIX

Much of my work in *A Rational Cosmology* depends on a threefold distinction among existents.

Existents are either entities, qualities, or relationships, and each of these designations is mutually exclusive. I have been asked, however, what counts as an entity. In Essay CXVIII: "Entities and Spatial Continuity", I provided an explanation of one of the necessary qualities of an entity, which I called *spatial continuity.* Here is how I described that quality:

> "Every entity — homogeneous or heterogeneous — must have continuity among all of its parts. The test for spatial continuity is this: is it conceivable for one to trace a path from any point on the entity to any other point without any part of that path entering a region of 'space-as-absence' – i.e., a region where the entity does not exist? If such a path is conceivable — no matter whether one' s current level of technological advancement actually permits one to trace it — the entity is continuous and is affirmed in this ubiquitous quality."

Having studied topology during late 2008, I was pleased to discover that a topological equivalent of my concept of spatial continuity exists. It is called *path-connectedness.*

Here is how James R. Munkres defines a *path* and *path-connectedness* in Chapter 24 of the Second Edition of his book, *Topology*:

Path: "Given points x and y of the space X, a **path** in X from x to y is a continuous map f: [a, b] → X of some closed interval in the real line into X, such that f(a) = x and f(b) = y."

Path-Connectedness: "A space X is **path connected** if every pair of points of X can be joined by a path in X."

A path-connected space is one in which any two points can be joined by a continuous function – a path – that never strays outside the space. To say that every entity is spatially continuous (as per my definition) is the same as saying that every entity is path-connected.

There is more that can be said about the ubiquitous qualities of entities by invoking the topological property of *compactness.* Compactness has a formal definition pertaining to every open cover of a space possessing a finite subcover, but for our purposes here, we need only to consider the Heine-Borel Theorem, which states that every closed and bounded subspace of an n-dimensional space of real numbers (R^n) is compact.

I argue in *A Rational Cosmology* that all entities are three-dimensional subspaces of R^3 and that every entity has a finite nonzero volume and finite dimensions of length, width, and height, which means that every entity is bounded. Of course, every entity also includes its own boundary and so is closed in topological terms. Therefore, every entity is compact.

Therefore, we can use topology to concisely state the ubiquitous qualities of entities:

(1) Every entity is a three-dimensional subspace of R^3.

(2) Every entity is path-connected.

(3) Every entity is closed and bounded – and therefore compact.

(4) Every entity exhibits the quality of matter (i.e., every entity is material). This is not a topological property, because topology only addresses spaces and not matter. However, Chapter XIV of *A Rational Cosmology* addresses my definition of matter in an accessible and concise fashion.

Any existent that meets the above four qualities is an entity; any presumed existent that does not is either not a genuine existent in itself or is a quality or relationship.

Related Essays

Chaos Theory is Not Chaotic

Before venturing into the subject matter of this treatise, a few definitions are required. The two mutually antagonistic concepts which are at the core of the present discussion are *order* and *chaos.* Reginald Firehammer, who mistakenly seeks to demonstrate that the universe is characterized by a fundamental disorder, writes in his essay, "Disorder, Chaos, and Existence", that the term, "order" tends to have two widespread interpretations:

> *"The two most common meanings are related: there is order in the sense of being, 'lined up,' or 'organized,' according to some priority or hierarchy; and there is order in the sense of uniformity or regularity. The important difference is that things can be orderly in the first sense (organized) and totally disorderly in the second sense (uniformity), and in fact, things organized in the first sense cannot be truly orderly in the second."*

This distinction is an accurate one, and necessary to identify precisely what the proponents of reason consider to be an "orderly universe." An orderly universe is *not* one which displays perfect uniformity or regularity; such a universe would need to be homogeneous, and, from simple empirical observation of the world around us, we know this to be false. All macroscopic entities are heterogeneous, composed of a variety of elements and structural arrangements thereof. Furthermore, entities are separated from one another spatially, and in the region of their separation, no entities exist. Had the universe truly been uniform and homogeneous, it would have consisted of one giant entity with absolutely constant texture and composition throughout, stretching for infinity in all three spatial directions, itself an inconceivable scenario.

Instead, an orderly universe is one which is "organized" according to premises that can be known and fathomed by the human mind. This organization was not imposed upon the universe by any external "higher" entity, unless that higher entity is man with his capacity to rearrange the

elements into even more orderly combinations. On the contrary, the organization is inherent in the natures of entities themselves. Every entity is what it is. By implication, it has a specific *identity* which describes what it is. Its identity is a sum of finite, measurable qualities which is distinct from the entire set of measurements for any other entity, but is related to the qualities of every other entity in some way (be it a certain distance of spatial separation, temporal separation, and/or a specific process or active relationship occurring among different entities).

If every entity has a finite, measurable identity, and these finite, measurable identities must be mutually related in some way, then it follows that this sum of identities and relationships constitutes the organization which defines an orderly universe. By the study of the entities' identities and relationships, it is possible to discern the underlying order for any given entity, quality, or relationship. There is no entity which is not orderly in a fundamental way, whatever the specific premise behind its organization might be, for the organization itself is what makes it possible for us to understand the entity's nature. If an entity lacks any sort of order, it cannot *possibly* be understood by man. Man would not even know that such an entity could exist! How could he have this knowledge if that entity had no clear, definite, *organized* manner by which to manifest its presence?

Human reason is defined as the ability to non-contradictorily identify elements of reality. If an entity is unfathomable by means of reason, it cannot be non-contradictorily identified. If it cannot be non-contradictorily identified, then there must be a fundamental contradiction in the very *assumption* that the entity exists. Any such contradiction can only be resolved by asserting that such an entity does not, in fact, exist. Therefore, *anything which cannot be fathomed by human reason also cannot exist.* Thus, in order to exist, any entity must have some sort of fathomable underlying order to it.

Since we defined order as fathomable organization, we shall now define chaos as the *absence* of order – i.e., the lack of fathomable organization. Since we have just demonstrated that anything without such an organization cannot possibly exist, it shall be the guiding premise of our further exploration that, indeed, truly chaotic entities and phenomena cannot exist in the universe.

The Misnamed Theory

"Chaos theory" is a branch of mathematics dealing with systems and phenomena which might defy one's original expectation of what orderly entities, qualities, and relationships consist of. David Harrison of the University of Toronto Department of Physics writes:

> *"When people began to study the systems we discuss below, they seemed utterly disorganized. Thus they were called 'chaotic.' As work progressed we discovered that hidden in the apparent disorganization was a great deal of structure. The structure shared by all of these systems then became the technical definition of these systems, which we continue to call 'chaotic.' So the technical meaning of chaos now means something quite different from the everyday meaning."*

We can thus understand that the name "chaos theory" did not stem from the fact that the existents it studied were truly chaotic, in the sense of not having any underlying order or structure. In fact,

despite the seeming disorganization upon first impression, there is indeed a vast amount of order in systems known as "chaotic" in the technical sense of the word. Indeed, the phenomena were first named as being chaotic, and *then* discovered, through closer examination, to be orderly on a fundamental level. The name for the systems and the theory describing them was not born of factual observation, but of hasty beforehand assumptions which were later refuted by deeper study.

Unfortunately, the name remained despite the known fact that the existents it described did not in fact exhibit true chaos. While the scientists and mathematicians themselves can get away with using such a name in their own realm of work by simply assigning a different meaning to it, such an approach creates immense confusion and harm in the public *perception* of science, mathematics, and the question of whether the universe is orderly.

However mathematicians might redefine "chaotic systems" to mean systems exhibiting a specific set of known, fathomable properties, the conventional definition of chaos, and, more importantly, the *philosophical* definition of chaos, is that of the absence of organization and structure. Thus, while mathematicians are in fact describing systems which are perfectly organized and fathomable in their own way, the rest of the world will interpret them as stating that "there are some things which cannot be known, because they lack any fundamental order." The popular perception of chaos theory is that of a "proof" that there are some absolutely random aspects to the universe which no individual can ever possibly know in full. It is true that the very notion of mathematics "proving" the inapplicability of order (on which mathematics itself is based) to some part of reality is a logical contradiction, but who would care about logical contradictions if it were thought that some aspects of the universe were off limits to logic?

It is therefore time for the name "chaos theory" to be changed. This name was coined due to assumptions which did not hold true; it contradicts the body of the theory it describes, and it fosters an improper perception of the universe in the eyes of the public, and, in particular, the non-scientifically specialized intellectuals. The name, "Theory of Subtle Order" might be a better indicator of the natures of the phenomena which are the province of said theory's study. The order within a given class of phenomena might indeed not be apparent to the untrained observer at first glance, but this does not mean that the order itself does not exist. It is simply more subtle and complex than the typical forms of organization. To state that whatever order one's first hunch is not capable of discerning is not in fact order, but rather "chaos", is a type of hubris which presumes, in essence, that "if I cannot see it right away, it must not be there at all."

I have used this Theory of Subtle Order to generate works of art that are both structured and complex, utilizing many layers of geometric forms and iterations of patterns. I use the term “Abstract Orderism” to refer to my fractal art, precisely because I see it not as chaotic, but as an expression of new emergent orders which cannot be achieved in any other way.

The remainder of this treatise shall be devoted to several brief explorations of how the basic systems studied by the theory under present discussion are in fact remarkably orderly in their own way.

Fractal Sets

Reginald Firehammer writes:

> *"Fractals are called 'iterative,' which only means, a particular equation is repeated over and over. In fractal math, the 'output' of each iteration of an equation, is used as one of the variables of the equation for the next iteration."*

A common fractal equation for the Julia and Mandelbrot sets is the recursive expression $x' = x^2+c$. That is, the subsequent term in the sequence is the square of the previous term plus some constant "c." Depending on choices for initial values of x and c, the sequence produced will be different. Where Mr. Firehammer errs, however, is in presuming that such a system somehow exhibits an inherent disorder of any sort. He writes: *"Two aspects of fractals are already apparent, however, no number ever repeats, and the results cannot be predicted, except in this case it can be predicted the numbers keep getting bigger."*

It is true that no number ever repeats in a fractal sequence, but it is unwarranted to assume that this is a mark of disorder. In fact, the simple recursive sequence, $x' = x+1$, in which the subsequent term is the previous term plus one, would never repeat a single term, yet to claim that a specific example of such a sequence, "1, 2, 3, 4, 5, 6, 7, etc.," is disorderly is surely false.

Furthermore, although the initial algorithm for a fractal sequence can only be defined recursively, this does *not* mean that the results are unpredictable. It only takes a different way of looking at the expression for the Julia set to see the underlying pattern, which can be extrapolated as many times as one sees fit.

Let us assume that we are starting with some initial value, X_0, and some given constant, c. The algorithm which we apply to every subsequent term is, again, $x' = x^2+c$. What results is the following:

$X_0 = X_0$
$X_1 = X_0^2 + c$
$X_2 = (X_0^2 + c)^2 + c$
$X_3 = ((X_0^2 + c)^2 + c)^2 + c$
$X_4 = (((X_0^2 + c)^2 + c)^2 + c)^2 + c$

What beauty, what order, what elegance! The number of c's in the expression matches precisely the subscript of the x, and there is precisely one X_0 term needed in *every* explicit formula for every term. As a matter of fact, one would be able to obtain the explicit formula for X_{1000} just by extrapolating the pattern above, though it would take one quite a long time to write it. Computers, of course, can produce and process such formulas in an instant. Furthermore, one could easily write out the formula for X_{1000} without ever bothering to determine X_{999} or any of those intermediate values in the sequence. One only needs to know how many parentheses and how many "c" values to include in the expression. (In this case, the minimum number of parentheses needed is one less than the number of the subscript of X, and the pattern of the parentheses' recurrence is constant and unchanging.) Any nth iteration of this algorithm is

perfectly predictable, provided that one knows the initial term X_0, the value of c, and the value of n (the number of iterations). Then, one can write out the explicit formula for X_n, in terms of X_0 and c, fill in the precise numerical values for X_0 and c, and thereby get a numerical output.

Let us examine another fractal set which Mr. Firehammer seeks to use to demonstrate the "disorderliness" of such sets. Mr. Firehammer writes:

> *"A better example is* ***(x-c)/x = x'*** *(x=1, c=3, x' is the value of x for the next iteration)*
>
> *The first iteration is therefore: (1-3)/1 = x', or -2/1= -2. The series begins as follows:*
>
> *-2/1 =* ***-2***
> *-5/-2 =* ***2.5***
> *-.5/2.5 =* ***-.2***
> *-3.2/-.2 =* ***16***
> *13/16 =* ***.8125***
> *-2.1875/.8125 =* ***-2.692307***
> *-.307692/2.692307 =* ***-.114285***
> *-3.114285/-.114285 =* ***.355918***
> *3.355918/.355918 =* ***9.428899***
> *6.428899/9.428899 =* ***.681829***
> *-2.318170/.681829 =* ***-3.399928***
>
> *The output of all equations produces a series of values: -2, 2.5, -.2, 16, .8125, -2.692307, -.114285, .355918, 9.428899, .681829, -3.399928, ... (All values have been truncated to 6 decimal places.) The series is indefinite and never repeats. Notice that the change in signs seems to be random. It is not random, because it is determined by the equation and input values, but cannot be predicted. In fact, no part of the series can be predicted."*

When one just visually examines the numbers, one is certainly intimidated at first glance. "What possible order can there be here?" one might ask. But the order is there, just waiting to be grasped. It is merely hiding behind an extremely thin veneer of apparent randomness. In fact, this algorithm is just as predictable as the Julia set. Let us examine the lineup of explicit formulas for it:

$X_0 = X_0$
$X_1 = (X_0 - c)/X_0$
$X_2 = ((X_0 - c)/X_0 - c)/X_0$
$X_3 = (((X_0 - c)/X_0 - c)/X_0 - c)/X_0$
$X_4 = ((((X_0 - c)/X_0 - c)/X_0 - c)/X_0 - c)/X_0$

There is a beautiful order here, once again. It is found in a *pattern* using which the explicit formula for any term in the sequence can be easily determined. Here, the minimum number of parentheses equals the subscript of the X, as does the number of X_0 terms in the expression. The number of "c" terms in the expression is one less than the subscript of the X, and the pattern by which parts of any given explicit formula recur is constant. By writing out the explicit formula

for any X_n, it becomes possible to predict the value of X_n without necessarily working out all the terms prior to it.

It is true that fractal sequences like the Julia and Mandelbrot set can only be known through an initial recursive formula, but this by no means implies that they are disorderly or unpredictable. Let the reader examine the following string of numbers:

1, 1, 2, 3, 5, 8, 13, 21, 34, 55, 89, 144, 233, 377, 610, 987, 1597, 2584, 4181, etc.

If the reader just *looks* at the numbers, the pattern does not display itself automatically. Is it thereby random or "chaotic"? By no means. As a matter of fact, this sequence, like the fractal sets, can only be known through a recursive formula. In this case, the recursive formula is $X_{n+1}= X_n+ X_{n-1}$. By the way, I have just given the reader the means to uncovering the underlying order of this sequence: each subsequent term is the sum of the previous two terms.

This, of course, is the famous Fibonacci Sequence. A curious tendency occurs regarding the ratios of each subsequent term over the term preceding it as the sequence continues indefinitely. These ratios approach an asymptote: the "transcendental" number 1.61803..., otherwise known as φ, or the Golden Ratio. From the time of the ancient Greeks onward, the Golden Ratio was thought to be the proportion representative of the ultimate beauty and the ultimate *orderliness* of the universe. And this portrayal of ultimate beauty and order can only be accessed through an initial recursive formula! Seeing this, can the proponents of the view that the universe is "chaotic" any longer accurately claim that fractal sets are indicative of universal disorder simply because they are recursive?

Quite the contrary, recursivity automatically *implies* an underlying order in a sequence which exhibits it. Recursivity entails the requirement of repeated iteration of the same function, and this repetition in iteration is in itself a pattern which can be shown more explicitly as well. One will be able to perform the same demonstration as I had done to show the underlying order of the two fractal sets above with any recursive sequence, fractal or not.

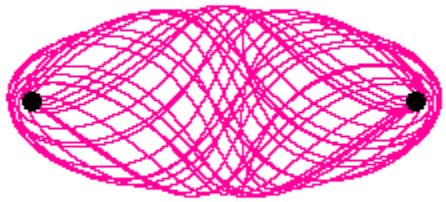
The Three-Body Problem

Another example of a system which is commonly called "chaotic" is the hypothetical case of a planet rotating about *and between* two "suns." The path of such a planet is complicated and does not repeat itself, unlike the fairly elementary elliptical path of a planet in orbit around a single sun. Because the path never repeats itself, it is assumed that, if it should continue indefinitely, we should get ever new trajectories for the planet to follow, which would thereby make its motion unpredictable and disorderly. This assumption is mistaken on several counts, however.

First, no matter how many entities are involved in a gravitational interaction, any *two* of them will follow Newton's Law of Universal Gravitation with respect to one another. That law is expressed as $F = G*m_1*m_2/r^2$, where F is the force of gravity on either body, G is the universal gravitational constant, r is the distance between the centers of the two bodies, and the subscripted m terms are the mass values for each respective body. Any gravitational interaction, no matter how complex, is just a finite set of interactions, each of which follows the principle of F =

$G*m_1*m_2/r^2$, an underlying principle for the system. If *each* gravitational interaction which is a member of the set can be known through the above universal law, then it follows that *all* members of the set can be thus known. In practice, the calculations required to achieve this knowledge might be numerous and time-consuming, but they are *capable of being performed*, as any underlying order such as this is capable of being explicated. Computers can speed up the process considerably, as the very "chaos" mathematicians themselves have discovered.

Second, it is a mistake to assume that *real* three-body systems with the planet coming in between the two stars would exhibit paths of motion which continue on indefinitely. Consider the picture accompanying this essay – the output of a computer model of a three-body interaction which has only been performed for eighty iterations (courtesy of David M. Harrison's "An Introduction to Chaos").



Let the reader note how dangerously close the planet would be getting to both of the suns so many times during only the first eighty time units of its rotation! The mistaken assumption this particular model makes is that of the point-like natures of the "suns" and the planet involved. The point model is a customary simplification for physical simulations, but in this case it presents a potentially grave misapplication of the three-body problem to reality. Real entities are always three-dimensional, and real planets are always three-dimensional spheres or spheroids. Simply put, if two spheroids were to get as close to each other as the above diagram suggests, they would collide into one another, and the motion along the path predicted above would stop! As a matter of fact, because temperatures of a given sun are likely to be colossal, the planet would be consumed and melted by the sun, and the three-body system would cease to exist. Thus, any path the planet would take would occur only over a finite, and likely rather small, number of time intervals. This implies that determining such a real-world path prior to collision would take a finite amount of applications of Newton's Law of Gravitation, which a computer would be able to do even if a human being could not. The finite path thus determined might curve every which way, but it would still be knowable via a definite algorithm and would thus be orderly in a fundamental sense.

It *is* possible to for a planet to orbit a binary star system *if* its orbit is entirely outside that of the two stars. Because the two stars are unlikely to be identically sized, the smaller star larger star would orbit the larger star, and the circumbinary planet (typically one that comes into the star system from the outside) would follow an orbit of a wider radius outside the two-star system. Sixteen circumbinary systems are known as of the release of the Third Edition of *A Rational Cosmology* in September 2013 (see the Wikipedia entry on circumbinary planets). In all of these systems, the two stars are comparatively close to one another, and their combined gravitational force upon the circumbinary planet or planets leads these planets to form stable elliptical orbits farther out. This is no different in principle from a smaller planet orbiting a single sun farther out than a larger planet – as is the case for Mars orbiting the Sun farther out than the Earth, or Neptune orbiting the Sun farther out than Jupiter. However, a planet that somehow found itself *between* the two stars of a binary system would follow a path that would soon lead to its collapse into one of the stars.

In response to this reasoning, Mr. Firehammer wrote on the now-defunct Autonomist Forum: "*The closest scientists have been able to come to solving the three-body problem is by assuming the bodies are single points in a single plane. Real bodies obviously are not points. Since they cannot even solve the problem for this model which reduces all aspects of the problem to simplest terms, it is obvious they cannot solve the problem for real bodies*." Mr. Firehammer's assumption is that a point model is necessarily simpler and easier to operate on than a model which incorporates the three-dimensional nature of entities. However, this assumption is false for cases such as this. The point model is in fact *more* laborious to apply here than the three-dimensional model, because the point model rules out the possibility of collisions between the planet and one of its suns, and would thus require one to continue extrapolating an indefinite, ever-different trajectory. Reductionism can often result in *more* work and *more* difficulty in arriving at an answer than an approach which does not rule out any known data, allegedly for convenience's sake.

My answer as to the orderliness of any trajectory of motion determined by three-body gravitational attraction is evident in reality itself. In fact, we observe that there are no known actual situations where a given planet exists between two suns; such solar systems are but the stuff of science fiction. We know why this is the case: any trajectory of such a planet is going to inevitably (and rather soon) result in a collision between two of the bodies. If there *had* been any such systems of planets between two stars in the universe's history, they would have quickly become obliterated. The only solar systems that remained were those with a single sun or with stars orbiting stars, which could facilitate the rotation of planets about the central star or stars in simple, repeating, elliptical orbits. The more stable and orderly a given deterministic system, the more reality favors it, and the more it is selected over less stable and less orderly systems.

Because of the inevitable occurrence of collisions in any gravitationally originated motion of a system with a planet in between two stars, we conclude that all situations involving such systems result in finite trajectories which can be relatively easily, for our technological level, understood and modeled via a guiding principle, Newton's Law of Universal Gravitation.

Characteristics of "Chaotic" Systems

Ample additional evidence can be found, demonstrating that the systems mathematicians and scientists refer to as "chaotic" in the technical sense are in fact quite orderly. Dr. Harrison provides a full description for the layman of some of the basic attributes and underlying principles of organization which are said to characterize "chaotic" systems. Here, I shall simply provide a summary citation so as to give an idea of the types of evidence for the validity of my thesis, which a deeper study of these systems will uncover. Such systems entail the following.

- ***Sensitive Dependence on Initial Conditions.***
- ***The trajectory never repeats.***
- ***They are nonlinear.***
- ***The transition to chaos is preceded by infinite levels of bifurcation.***
- ***The infinite bifurcations preceding the transition to chaos are characterised by the Feigenbaum number.***
- ***Fractional dimensionality.***
- ***A Lyapunov plot of the distance between trajectories versus time will exhibit a straight line.***
- ***The initial points of the first return map always lie above a line making an angle of 45 degrees with the horizontal.***

"Thus, hidden in the apparent disorganization is a great deal of structure. [Harrison's words, not mine, but further supporting my point.]"

"Chaotic" systems are not chaotic at all, in the layman's and the philosophical sense of the word. Chaos is the absence of structure, but these systems exhibit a plethora of organization. Such systems are only a specific *type* of mathematical and physical scenarios which are grouped together into their own branch of study because they share certain common, underlying properties. It is a worthwhile endeavor to study these systems and their properties, precisely *because* such study will uncover *more* underlying order behind them. This underlying order, aside from being understood, can be *applied* by man to manipulate entities in the absolute reality so as to best serve his own interests. It can be used, for example, for modeling short-term weather trends, or for discovering the structure of a fern plant, or for attaining an understanding, as I have demonstrated, of why systems with planets in between two or more suns are impossible in the real universe.

"Chaos theory" remains, at its core, a branch of mathematics, and mathematics cannot be used to show its own inapplicability to reality. No system can, within its own premises, refute itself, unless it is self-contradictory, which mathematics is not. Mathematics is specifically defined and structured so as to exclude the possibility of contradiction, for mathematics is an outgrowth of logic, which Ayn Rand called "the art of *non-contradictory* identification."

As a means of describing the orderliness of certain existents, "chaos theory" should be welcomed and explored further. However, it is in need of an urgent name change, for it is truly the "Theory of Subtle Order", which supplements, not refutes, the rationally comprehensible nature of all of existence. There is no province of knowledge inherently off limits to man, for what cannot be

known, cannot be. Let us not take our newly discovered key and use it as a justification for throwing away the hand of reason which must use it to unlock all the mysteries of the universe.

Five Arguments for the Non-Existence of God

As an atheist, I have often been asked to give my reasons for my fundamental disbelief in God. This is an opportunity to present the essence of some of my ideas on this subject. The reasons I personally reject religion are extremely specific and manifold, and the following list is by no means exhaustive. The fundamentals of my ideas about the universe are thoroughly elaborated on in *A Rational Cosmology*. This essay is an adaptation of some of these ideas to the question of God in particular – along with some elaborations not present in *A Rational Cosmology*.

1) The Universe Creation Argument

God is said to be the Creator of the universe and all that exists. There I have my first issue. In *A Rational Cosmology*, Chapter II, subtitled "The Universe", I write the following as to why the universe could not have been created:

> *If it is true that the universe is "everything that exists," and it could be created, then, whatever entity could create the universe, would be outside that universe. It follows, then, that such an entity would be outside "everything that exists". An entity "outside" existence does not exist! A non-existent entity cannot do anything. Creation is an action that an entity must perform; it cannot be performed if the entity that would perform it does not exist!*
>
> *It is instructive to note that this principle automatically refutes both the theory that "God created the universe," as will be shown here, and that "the Big Bang created the universe," as will be shown subsequently.*
>
> *Even if it were possible that all currently known entities were intelligently designed, they could not have been designed by a being that is somehow "beyond existence".*
>
> *Rather, this being would need to be a delimited entity in its own right, with its own peculiar attributes (qualities) and capacities for action (relationships with other entities). Let the reader recall that everything which is or happens must in some manner involve some entity or entities. There are no such things as "pure" qualities, "pure" relationships, or "pure" creation, apart from the entities that exhibit, relate, and create.*
>
> *Any Creator of other entities would thus need to exist and be a part of the universe, and it would need to relate to other entities in some manner, as a human creator relates to the entity "brick", when he constructs the new entity "building". The Creator would not be able to create the universe, the latter being a contradiction in terms.*
>
> *But, in most variants of the monotheistic religions, God is not defined as an entity. As a matter of fact, God is defined precisely as a non-entity, something which does not only*

lack any set qualities, but which cannot possibly be understood or perceived by anyone anywhere in the universe.

God clearly fails the third corollary of identity, which states that any entity must have some relationship to everything else that exists. God also fails the first and second tests, as it is not defined what qualities God has. If God created the universe, He cannot have any qualities whatsoever, because the universe encompasses every entity that exists and thus every entity that can have qualities.

2) The Infinity Argument

There are many corollary reasons to the above argument as to why I reject the existence of God. God is typically defined as "infinite" in his capacities: omnipotent, omniscient, omnibenevolent, etc. Infinities (or, more properly, simultaneous infinities) are not logically admissible, as I demonstrate in *A Rational Cosmology*, Chapter IX, subtitled "Mistakes Concerning Infinity".

The true infinity, or a simultaneous infinity*, concerns either coexistence of infinite and finite measurements or the presence of all infinite measurements within an entity.*

God has been defined by the religious as an object of allegedly infinite quantities of everything – i.e., omnipotence and omniscience. However, the rational man would need to reject God by this definition*, because it implies a simultaneous infinity. The technique of measurement-omission cannot be applied to the formation of the concept "God", and thus "God" cannot be a legitimate concept unless it is a hypothetical God that* does *have a finite age, and exhibits delimited qualities and abilities. (And, simply because something is* conceivable*, does not guarantee that it* exists*; the existence of such a conceptually legitimate God would still need to be* proven *in order to be within the realm of reason.)*

3) The Infinite Regress Argument

This is the argument: Assuming God created everything that exists, then what created God? What created the thing that created God, and so forth? We can ask this question any number of times and still have the question remain valid (and parts of it unanswered), assuming that we grant the existence of God. This is also logically impermissible, as reason holds that anything can be understood in a finite series of observations and logical deductions.

The answer to this dilemma is to employ the technique of Occam's Razor. (William of Occam himself was a theologian, it is true, but, in his studies, he inadvertently developed a method which, when taken to the extreme, challenges the very foundations of religion.) Occam's Razor says that we must always take the simplest working explanation for anything, within the context of the evidence that we have available. If the simplest explanation for why letters are appearing on my computer screen right now is that my hand is typing them into the keyboard, it is logically impermissible to then have a theory which is more elaborate. An example of such a theory might be that there is an invisible green hippopotamus somewhere in the Alpha Centauri star system which is telekinetically manipulating the keyboard of my computer, while I have in reality been

knocked out by the hippopotamus's minions here on earth, bound, gagged, and given a hallucinogenic drug to make me think as if it is my hand which is typing this right now. There is no evidence to contradict the above theory directly, but there is also no evidence to support it. In the absence of evidence to support anything, we always presume its absence and embrace, as per Occam's Razor, the simplest working explanation for anything whatsoever – provided that the explanation is consistent with the rest of reality.

Here is what Occam's Razor tells us on the question of what created the universe: The simplest working explanation is that the universe did not need to be created. The universe just is, always was, and always will be. Granted, particular entities in the universe changed. Star systems formed and disintegrated. The Earth was once a cloud of dust particles, and our distant ancestors were once single-celled organisms. But existence itself (i.e., the universe) always existed. We do need to undertake infinite regress to speculate as to what created the Creator, because even the very question is not a logical one to raise. The universe can be explained just fine without God, or without the Big Bang, or without any theories whatsoever about universal creation and/or destruction. (In *A Rational Cosmology*, Chapter II, I demonstrate the fallacious characters of both the idea that the universe can be created and the idea that it can be destroyed.)

4) The Omnibenevolence Argument

If God is both all-powerful and all-good, why did he permit for so many of his loyal followers to endure unspeakable suffering, or to inflict unspeakable horrors, often in the name of God? Why did he permit the Catholic Church to establish the Holy Inquisition in the Middle Ages, or to embark on Crusades, or to burn heretics at the stake? Why did he permit the armies of Islam to ravage the Mediterranean world and their successors today – the Islamic fundamentalist terrorists – to attack Western civilization, including many sincerely religious individuals? Why did he allow millions of Jews to perish during the Holocaust? The standard response is that God gives people free will to act as they please. But is it just on God's part to allow some people to use free will to violate his strongest moral commandments? Can such a God exist and be called just?

By the way, religious texts say that divine intervention on the behalf of victims is quite within God's capacity. For some reason, he was partial to Moses and the Jews when he allowed the Red Sea to part before them in their exodus from Egypt. He was partial to Joshua when he allowed the walls of Jericho to crumble. Yet he was unable to save far greater numbers of his followers at later dates from perishing due to greater crimes and dangers. What explains the contradictions, or the pickiness, on his part?

I get, from this, the following ideas about God. Option 1 is that he is all-benevolent, but not all-powerful, and sincerely wishes for his followers to endure only good, but is not able to intervene at all times due to limits on his capacity, in which case this is not the picture of God advanced by any major religion. As a matter of fact, one could say that any charitable businessman, like Bill Gates, is God under this model. He is benevolent, he helps people a lot of the time, but he cannot help everybody or save everybody. Option 2 is that God is all-powerful, but not all-benevolent, in which case there is no reason to worship such a creature. (The Vikings had a religion of malevolent gods who would eventually destroy themselves and the world in a massive last battle, but I do not think anyone wishes to emulate the Vikings.)

There is a third option here, and it is the one I embrace. God is neither all-powerful, nor all-benevolent, because he does not exist. This is the model that logically reconciles the fact that religious people are not protected from harm by divine intervention with the fact that these people are often moral and worthy of such protection. It is unfortunate, yes, but true.

5) The Free Will/Omniscience Argument

God is said to be all-knowing. This means that God knows everything that will happen at any time, including the future. But that implies that God knows what we will choose in the future. If God knows what we will choose in the future, how can we have free will, since our choices are already determined by what God knows them to be? But then, it is also said that God gave people free will, so how can this contradiction be reconciled?

My answer is that free will undeniably exists. It is what is called an epistemological axiom; we cannot even attempt to refute it without implicitly confirming it in the process. In the attempt to deny free will, we are exercising our free will. But, to consistently embrace the existence of free will, one must reject the possibility of anybody being omniscient about the decisions anybody else will make in the future. Thus, God, by the standard definition, is ruled out.

Praxeology and Certainty of Knowledge

Introduction

The discipline of praxeology, as formulated by Ludwig von Mises, affirms the ability of the human rational faculty to deductively obtain certain knowledge about aspects of reality. The starting point of praxeology, the action axiom, is both irrefutable and ubiquitously manifested in reality. The action axiom thus serves as a link between observation and reason, allowing the latter to accurately systematize and gain true insight into the former. Praxeology repudiates all doctrines which seek to sever reason from reality and which contend that certain, rational knowledge is impossible, including empiricism and historicism.

The Action Axiom

Praxeology, the science of human action, begins with the action axiom. Action, exhibited by all humans, is "purposeful behavior" (Mises 11). An acting man perceives a certain set of ends as subjectively valuable and then chooses means that he thinks will attain those ends. The goal of all action is ultimately the satisfaction of the individual actor: "Acting man is eager to substitute a more satisfactory state of affairs for a less satisfactory. His mind imagines conditions which suit him better, and his action aims at bringing about this desired state" (Mises 14). In order for action to occur, two conditions must be met. The actor must be dissatisfied in some manner. Furthermore, the actor must consider himself capable of remedying his specific dissatisfaction. If this is so, then the actor will pursue the dissatisfaction's elimination, provided that the benefit of eliminating it exceeds the disutility of his own labor in doing so.

From the perspective of the agent, all action is "rational" in the sense that it has *reasons* behind it: the agent thinks that the means he chooses will bring about the ends he desires. The acting

man may be mistaken in his interpretation of the facts of reality and might therefore falsely perceive causality where none exists. In retrospect, he might realize his past mistake and adjust future actions accordingly. However, it remains true that he had a clear reason behind his past decision, based on false information though it might have been.

Furthermore, the action axiom encompasses any conceivable *nature* of a man's means and ends. The ends can be goals of the mind or the body or both, moral or immoral or neither, and relying on any possible set of means accessible to a human being. According to Mises, "All ends and all means, both material and ideal issues, the sublime and the base, the noble and the ignoble, are ranged in a single row and subjected to a decision which picks out one thing and sets aside another" (3). The existence of human action implies that the actor arranges the entirety of the ends available to him on a single ordinal value scale: he pursues the end which he considers most valuable at a given time. Subjectively, the actor knows his value hierarchy and why he selected to pursue the end he did. For the observer, however, the only way to know that an actor valued X over Y at a given time is if the actor actually chose to pursue X rather than Y. Acting *is* the way actors manifest the nature of their individual value scales.

Moreover, the abstinence from certain purposeful activity that an actor considers open to him also constitutes action: "A man who abstains from influencing the operation of physiological and instinctive factors which he could influence also acts. Action is not only doing but no less omitting to do what possibly could be done" (Mises 14). Volitional abstinence is action in that the actor deliberately chooses the consequences of non-interference with a given factor of reality over the consequences of interference. The former rank higher on his subjective value scale than the latter. Hence, where man has free will, he acts. If his free will chooses to do something, he acts; if it chooses *not* to do something, he also acts. Action is an inescapable corollary to man's volitional nature.

Furthermore, the existence of action is axiomatic since even the very attempt to deny it will bring about its further affirmation (Hoppe, "Praxeology and Economic Science: Sec. I," *Economic Science and the Austrian Method*). The attempted denial of the action is an action in itself. The agent undertaking it seeks an end: the disproof of the action axiom. He also selects a means toward this end: his argument. Of course, his choice of means indicates a misapprehension of reality on his part, since no argument can refute the action axiom. However, the agent *believes at the time of his action* that he can refute the action axiom by such means; hence, though his belief is false, he is still *acting* toward his chosen end.

Indeed, acting can be said to be a prerequisite for humanity: "[Man] is not only *homo sapiens*, but no less *homo agens*. Beings of human descent who either from birth or from acquired defects are unchangeably unfit for any action (in the strict sense of the term and not merely in the legal sense) are practically not human" (Mises 15). Indeed, if we grant that all human beings have free will, a man who does not act in some way is inconceivable. "Action is will put into operation and transformed into an agency" (Mises 3), and a man who does not act would either not have a will (i.e., not be a man) or not be able to transform it into an agency. Will without agency is meaningless: a hypothetical creature who possessed it would, for example, *want* to move its arm and *direct* it to move without actually moving it. It would *want* to form thoughts, but not be able to do so, since the actual deliberate construction of thoughts is an action in itself. Such an entity

would not be able to direct itself either physically or mentally: its "will" would be severed from all of reality and, not having a relationship to anything else, would be practically nonexistent. Of course, such a creature cannot exist: one cannot have the ability to consciously, deliberately *want* without having the ability to *think*, a category of action. Thus, a creature with will but without agency is a contradiction in terms. Will implies agency; man, being volitional, acts. He acts both by doing and by not doing, provided that he has will, which we know he does.

We have thus analyzed the identity, universality, and incontrovertibility of the action axiom; we have demonstrated its inseparability from human nature itself. Now we shall show how it serves as a bridge between human reason and observation.

Reason and Observation

Via the action axiom, praxeology bridges a significant gap in Kantian epistemology: it explains how man's reason can accurately interpret his observations and thereby know reality.

According to Austrian school economist Hans-Hermann Hoppe, the existence of action, like all axioms, is an *a priori* synthetic proposition: "Synthetic a priori propositions are those whose truth-value can be definitely established, even though in order to do so the means of formal logic are not sufficient (while, of course, necessary) and observations are unnecessary" ("Praxeology and Economic Science: Sec. I"). If we tried to purely deduce the existence of action from more basic starting premises, we would not be able to do so. The very use of logic (a means) for the purpose of proving the existence of action (an end) constitutes an action in itself; hence, we cannot use logic alone to prove that on which our very use of logic is already predicated. Furthermore, we cannot induce the action axiom purely from observing the data of external, physical reality. All that we would gather by such a method would be the movement of certain material entities: human beings and the objects they manipulate. We would obtain no understanding of those entities' *purpose* by simply observing their exterior forms.

Yet, while we cannot deduce or induce the action axiom, we know that it is true. Immanuel Kant himself recognized that a priori synthetic propositions, despite being neither provable nor observable, are unavoidably correct: "Kant's answer is that the truth follows from self-evident material axioms... They are self-evident because one cannot deny their truth without self-contradiction; that is, in attempting to deny them one would actually, implicitly, admit their truth" (Hoppe, "Praxeology and Economic Science: Sec. I"). If we know that a priori synthetic propositions are true, how, then, do we arrive at them?

The way we know the truth of the action axiom is an alternative to *both* sides of the traditional reason-observation dichotomy and a means by which this dichotomy can be transcended. This method is *introspection.* According to Hoppe, "the truth of a priori synthetic propositions derives ultimately from inner, reflectively produced experience:" we know their validity by examining the nature and function of our own minds and their basic similarities to the minds of other men. We know of the existence of action because we are actors ourselves; we constantly and consciously select ends to pursue and means by which to pursue them. Our minds are aware of our status as acting beings. Other humans communicate their choices of means and ends to us, and we recognize fundamental similarities between their modes of functioning and ours. When

we observe them engaged in a certain activity, we know that *they* are acting; we know this because *we* can act and would *have* to act if we were engaged in the same activity as they.

Some might object to the inference that other people are volitional, acting beings like oneself. These critics would state that the attribution of will and agency to *others* is just a hypothesis on the observer's part, not conclusively warranted by the mere observation of others' physical movements. Their argument alleges the impossibility of conclusively *knowing* that other people have consciousness, volition, and agency. In the critics' opinion, the hypothesis that other people act might be convenient in making sense of their physical movements, but it need not be the *only* true hypothesis, nor can it be verified with certainty.

These critics are mistaken: they fail to grasp that action is both a priori synthetic *and* physical. Even though external observation is not necessary to understand the existence and meaning of action, action applies to the external, physical reality: every man *acts* in that reality. The body and mind of the acting being are physical existents: a certain fundamental physical nature enables the human body and mind to act. By sheer introspection, any given acting man can conclude: "The way my body and mind are enables me to act. *Any entity* with the essentially same structures of body and mind, functioning in the same way, will also be capable of acting." One can arrive at this insight without *ever* encountering another acting being. However, *when* one encounters beings with a fundamentally similar physical structure to one's own, one knows, through introspection, that they, too, are acting entities.

Other creatures with different fundamental physical natures, including plants and the lower animals, lack the capacity to act in the praxeological sense, since they lack volition: their existence is sustained by instinct and reflex. The acting man sees that these creatures are fundamentally different from him in body and mind and therefore concludes that they cannot act. However, all humans share the same fundamental physical nature: their bodies exhibit a similar appearance – all particulars of bodily dimensions, color, gender, and miscellaneous small details notwithstanding. Furthermore, the essential physical structures of every man's brain and sense organs are the same. An acting man encountering any other man will realize: "This man fulfills my previously arrived-at criterion for acting beings, since he is fundamentally similar to me in his characteristics, and I know that I am an acting being."

The universality of action among human beings is no mere hypothesis: it is a fact knowable with certainty. Just because we can only discover the existence of action by looking into our own minds does not mean that action is a product of our imagination, severed from reality. On the contrary, "our mind is one of acting persons. Our mental categories have to be understood as ultimately grounded in categories of action. And as soon as this is recognized, all idealistic suggestions immediately disappear" (Hoppe, "Praxeology and Economic Science: Sec. I"). The existence of our actions in reality is the very reason *why* we can introspect to discover the *fact* that we act. Implicit in action is the pursuit of ends via *real* means: even if the ends the actor pursues are in fact non-existent, such as the favor of the great Rain Spirit in watering his crops, his means toward pursuing that end must exist in this reality. If he does a rain dance to obtain the fictitious spirit's favor, he will be dancing with a real, physical body upon real ground, asking the Spirit to pour water on real crops.

If a man acts, he must necessarily be linked to reality and able to pursue real means; otherwise, he would not be able to act. Man understands the real nature of his actions through the use of his mind, through introspection. In fact, introspection is itself an action, as are all the fundamental processes of man's mind: as "categories of action, they must be mental things as much as they are characteristics of reality. For it is through actions that the mind and reality make contact" (Hoppe, "Praxeology and Economic Science: Sec. I"). Action can be manifested in external reality, but it requires the mind to grasp. It cannot be *solely* a mental category detached from the outside world, since it is the prerequisite for and determinant of all human mental categories. Nor can action be a *solely* empirical category distinct from the operations of the individual actor's mind, since the mind, aside from being necessary for introspection, assigns to acting man his choice of ends and means. Action can be grasped by neither reason nor observation alone; in bridging the two, however, it affirms the validity of both. Since man's mind belongs to a being acting in reality, its analytical faculty – its *reason* – can accurately interpret human *observation*, or the data of reality as available to the human senses. Moreover, since *every* man is an acting being, *every* man has the capacity to reason accurately and make accurate observations, if he chooses to use that capacity.

Certain Knowledge

Since, following from the action axiom, man's reason can accurately interpret his observations, it can thereby obtain fully correct, certain knowledge about aspects of reality. The science of praxeology consists of a systematic collection of certain knowledge derived from the action axiom and known to be true. Just as the action axiom is irrefutable, so are the propositions stemming from it. Man can know the truth of praxeological propositions fully and absolutely: no amount of further experimentation or empirical evidence can refute them.

> "Its statements and propositions are not derived from experience. They are, like those of logic and mathematics, a priori. They are not subject to verification and falsification on the ground of experience and facts. They are both logically and temporally antecedent to any comprehension of historical facts. They are a necessary requirement of any intellectual grasp of historical events." (Mises 32)

Praxeology offers synthetic *a priori* insights about reality. It requires no observation to arrive at, but nonetheless offers knowledge that no observation can possibly refute, and many observations will confirm. Furthermore, praxeology is synthetic *a priori true*, because its starting point, the action axiom, is irrefutably correct. Praxeology is not merely *analytic a priori*, since it requires more than the mechanisms of formal logic to confirm: one has to be an acting being oneself in order to know of action and praxeology. While formal logic is necessary in explicating praxeology, it is not sufficient: logic is a category of action and must be preceded by it. Axioms, like the proposition that humans act, cannot be proved by means of logic alone. They are the starting points of logical systems and thus cannot be arrived at from within the systems themselves. Their truth is known more fundamentally: any attempt to refute them implicitly confirms them.

The action axiom makes possible the acquisition of a plethora of *a priori* knowledge about reality. *A priori* true economic propositions, however, are arrived at with especial directness:

"Economic propositions flow directly from our reflectively gained knowledge of action; and the status of these propositions as a priori true statements about something real is derived from our understanding of what Mises terms 'the axiom of action'" (Hoppe, "Praxeology and Economic Science: Sec. I"). Economics, as a subcategory of praxeology, is rationally knowable not merely *because of* the action axiom, but as a *direct derivation* from it. For example, the law of diminishing marginal utility can be deduced from the action axiom. In acting, a man uses a given economic good to fulfill a set of available ends. If he values a given end above all others, he will devote his first unit of the relevant good to that end, since his valuation of that end can only be observed via the actions he takes to pursue it. He will necessarily devote his second unit of the same good to the second most subjectively valued end he deems attainable via that good's use. The value the actor derives from the use of the good's second unit is thus necessarily less than the value obtained from using its first unit: the second most valuable end is necessarily less valuable than the first. Such reasoning can be extrapolated indefinitely, applicable to as many units of a good a given economic actor might have, no matter what the identity of the actor and of the good in question might be. The law of diminishing marginal utility holds for all time periods – past, present, and future – and no empirical datum could conceivably refute it.

But the propositions of economics are not the sole extent of *a priori* knowledge made possible by the action axiom's existence. Indeed, to clearly delineate the bounds of knowledge that can be arrived at via an axiomatic-deductive approach, another *a priori* truth is needed: "that humans are capable of argumentation and hence know the meaning of truth and validity" (Hoppe, "On Praxeology and the Praxeological Foundations of Epistemology: Sec. III"). Hoppe's axiom of argumentation, like the action axiom, cannot be consistently denied. One's attempted refutation of the existence of human argumentation would itself be an argument.

Metaphysically, argumentation is a subclass of action: to argue is to select a set of verbal and logical means to pursue the end of demonstrating something to be true or false. However, epistemologically, argumentation is prior to action: "without argumentation nothing could be said to be known about action" (Hoppe, "On Praxeology and the Praxeological Foundations of Epistemology: Sec. III"). The only way one can use argumentation is if one is an acting being. However, the only way one *knows* that one is an acting being is by using one's reason and exercising argumentation. If one did not use argumentation (including abstaining from attempting to deny one's argumentative capacity), one would never know *that* one is an acting being – nor would one be able to *articulate* to oneself or others *why* one pursued a given course of action. One would have to choose ends and means without knowing *why* one chose them. This is a contradiction in terms: the very concept of ends and means makes no sense without the actor's exercise of reason. Saying or thinking, "I chose means X to get end Y," constitutes an argument and a reason for one's action. Without the ability to convey this reason to at least oneself, one would not be able to act at all. The capacity to act implies the capacity to use argumentation.

Only through argumentation can one arrive at the action axiom and the praxeological knowledge following from it. But because argumentation is, in fact, based on action, it can arrive at certain truths: "the possibility of argumentation presupposes action in that validity claims can only be explicitly discussed in the course of an argumentation if the individuals doing so already know what it means to act and to have knowledge implied in action" (Hoppe, "On Praxeology and the

Praxeological Foundations of Epistemology: Sec. III"). Since we are beings who act in reality, our argumentation – being a type of action – is also in and of reality.

It is possible to argue falsely: this would be a specific case of using improper means to achieve a desired end. However, correct argumentation is similarly possible, as is a more general case of using means that actually fulfill a given actor's goals. If it were impossible to act correctly, then no means selected by humans would ever arrive at ends those human beings aimed at. Since we observe ubiquitously that human beings frequently select proper means to actually fulfill their ends, we know that a correct pairing of means and ends is possible. Since argumentation facilitates the pairing of means and ends, correct argumentation must be possible as well. If correct argumentation were impossible, so would *any* sort of eradication of dissatisfaction – which can only come about from reaching one's chosen ends. Furthermore, if *no* human ends – including basic survival needs – were met, all humans would be long dead. We know that many humans exist and routinely remedy dissatisfactions; therefore, much of their action and argumentation must be correct.

Since argumentation pertains to reality, man can obtain knowledge about reality by using argumentation correctly. Knowledge, the product of argumentation, is then itself a category of action.

If argumentation is a subclass of action, then the realm of *a priori*, certain knowledge can be described as the realm of propositions that can be arrived at argumentatively, without being contingent on any additional external observations. According to Hoppe, the "task of epistemology [is] that of formulating those propositions which are argumentatively indisputable in that their truth is already implied in the very fact of making one's argument and so cannot be denied argumentatively" (Hoppe, "On Praxeology and the Praxeological Foundations of Epistemology: Sec. III"). According to Hoppe, epistemology must then "delineate the range of such a priori knowledge from the realm of propositions whose validity cannot be established in this way but require additional, contingent information for their validation, or that cannot be validated at all and so are mere metaphysical statements in the pejorative sense of the term metaphysical." Proper epistemology will tell us which facts can be known through reasoning and introspection – and which require specific observations to verify; furthermore, it will tell us which propositions are absurd or altogether irrelevant to reality. The action axiom enables such an epistemology to claim that man can be certain in the accuracy of *both* his *a priori* knowledge and his observation – that no fact of reality is *inherently* off limits to human comprehension.

Any denial of knowledge inextricably linked to the axioms of action and argumentation would entail a contradiction of one's own argument and would be refuted by one's very *ability* to argue. Furthermore, the realm of a priori knowledge is praxeologically constrained: it is only as broad as the categories of human action allow it to be. It is possible to have genuine *a priori* knowledge *about* something other than action, but the very pursuit knowledge can only be *facilitated* by action. Knowing is an end toward which deliberate physical and mental activity is a means. This praxeological constraint is in fact an assurance: it allows us to understand all genuine *a priori* knowledge as knowledge of reality, and not merely of the categories of our own minds. Hoppe explains: "Acting is a cognitively guided adjustment of a physical body in physical reality. And thus, there can be no doubt that a priori knowledge, conceived of as an insight into the structural

constraints imposed on knowledge qua knowledge of actors, must indeed correspond to the nature of things" ("On Praxeology and the Praxeological Foundations of Epistemology: Sec. III"). Because action necessarily exists in physical reality, *a priori* knowledge, being a subcategory of action, must also pertain to that reality. Action and, in particular, argumentation provide a figurative bridge through which the data of reality can enter our minds and reside there without being vulnerable to further disproof or rejection.

The ability to arrive at certain *a priori* knowledge about reality deals a decisive blow to two doctrines denying the possibility of accurate axiomatic-deductive theoretical insights: empiricism and historicism.

Refutation of Empiricism

Empiricism claims that the only true knowledge about reality is empirical and observational; furthermore, such knowledge cannot be held with certainty, because it is always contingent on future observation. To the empiricist, every item of knowledge must be arrived at via some particular observation and must be potentially open to falsification by some other particular observation. The empiricist considers any certain knowledge to be by definition unfalsifiable and therefore meaningless and irrelevant to reality.

Commenting on the practical consequences of empiricism, Mises notes that "[i]t is a mistake to set up physics as a model and pattern for economic research" (6). Indeed, the empiricist seeks to impose the methods which have apparently led to progress in the physical sciences upon all other disciplines. Empiricism's consequences in the field of economics include the experimental testing of propositions that rightfully belong to the realm of praxeology. Instead of arriving at economic laws from irrefutable starting insights into the nature of human action, the empiricist proceeds to gather particular economic data first and create a contingent theoretical model on the basis of that data. The model is judged on its capacity to predict future economic events, rather than on its consistency with far more fundamental and reliable insights necessarily following from action itself.

However, Mises realizes that the empiricist conceit of applying experimental methodology to all areas of study merely betrays an ignorance of the roles of logic and of all methods outside the scope of a laboratory scientist's field of work: "The research worker in the laboratory considers it as the sole worthy home of inquiry, and differential equations as the only sound method of expressing the results of scientific thought. He is simply incapable of seeing the epistemological problems of human action. For him economics cannot be anything but a kind of mechanics" (Mises 9). Empiricism, in imitating the methods of the natural sciences, implicitly ignores the very existence of human action. So doing, it encounters a major problem: human beings are not readily experimented upon.

Man's behavior, unlike that of inanimate nature, is not deterministic. Inanimate entities have specific natures which necessitate identical responses in identical circumstances. These entities cannot deliberately affect their own responses to make them different from what they otherwise would be. Furthermore, contrary to the assertions of quantum physicists – grounded in improper epistemology – no act of observation can magically alter the observed inanimate entities'

behavior without impacting physical causality and thus altering the entity's circumstances. *If* a given act of observation alters physical causality, it will always do so in the same way and produce the same result with regard to the observed entity.

Human beings, on the other hand, *choose* the course of action they will follow; they select their values and the means by which they will obtain or secure them. Tweaking a given variable does not necessarily guarantee a similar outcome for all human experimental subjects. Furthermore, unlike inanimate objects, humans can *know* that they are being experimented on and adjust their behavior accordingly. Human beings are autonomous agents, not mere passive respondents to the experimenter's influences and designs. The behavior of other acting humans cannot be infallibly predicted except when it can be logically traced to the nature of action itself. The empiricist, by denying himself the latter pursuit, throws away the most powerful and accurate economic tool available to him.

Hoppe offers another refutation of empiricism, starting from that doctrine's fundamental premise: that no knowledge can be categorically *a priori* true. He proceeds to show how following this premise to its logical conclusion results in absurdity. A consistent empiricist would have to claim that even the central empiricist tenet itself is "merely hypothetically true, i.e., a hypothetically true proposition regarding hypothetically true propositions, [which] would not even qualify as an epistemological pronouncement" ("On Praxeology and the Praxeological Foundations of Epistemology: Sec. II"). The empiricist faces two options. Either he must assert the central empiricist tenet's correctness categorically – hence laying claim to certain, unfalsifiable, *a priori* knowledge – or he must concede that the validity of empiricism itself is a mere hypothesis, open to falsification by later observations. The latter option also renders possible the existence of *a priori* knowledge: empiricism "would then provide no justification whatsoever for the claim that economic propositions are not, and cannot be, categorically, or *a priori* true, as our intuition informs us they are" (Hoppe, "On Praxeology and the Praxeological Foundations of Epistemology: Sec. II"). If empiricism is a mere hypothesis, the empiricist would have no means to categorically assert that economic knowledge *cannot* be *a priori* true. Empiricism, under such an assumption, would become vulnerable to refutation by the first demonstration of true *a priori* knowledge to come along. We have already discussed some such evidence, including the *a priori* natures of action, argumentation, and the law of diminishing marginal utility. Because *a priori* economic laws are true ubiquitously, their predictive power, too, far exceeds the empiricists' own contingent theories – and has done so since the inception of the Austrian school of economics. Under the empiricists' own basic assumption, such demonstration suffices to falsify the empiricist hypothesis.

Furthermore, aside from praxeology itself, a vast quantity of *a priori* knowledge can be derived from logic, arithmetic, and geometry. The success of each of these disciplines demonstrates the falsehood of the empiricist hypothesis in practice. Hoppe posits the necessary consistency of logic with reality due to human action:

> "In each and every action, an actor identifies some specific situation and categorizes it one way rather than another in order to be able to make a choice... [S]imply by virtue of acting with a physical body in physical space we invariably affirm the law of contradiction and invariably display our true constructive knowledge of the meaning of

'and' and 'or.'" ("On Praxeology and the Praxeological Foundations of Epistemology: Sec. III")

Acting man knows the validity of the conjunction "and" because he can pursue one action, then pursue another. He can describe this succession of pursuits as pursuing action X *and* action Y. Furthermore, acting man knows the validity of the conjunction "or" because acting implies making choices on one's value scale – prioritizing in pursuing higher-ranked values by devoting more attention to them than to lower-ranked values or ends that are of no value to the actor. Acting man always faces choices between some actions and others: he can pick action X *or* action Y, with X as the opportunity cost of Y and vice versa. "And" and "or" are necessary in describing action and thus are not only true but indispensable tools for fathoming reality. Logical categorization is a part of action, which is a part of reality. Therefore, logical categorization, properly performed, is, too, a part of reality and a means to an accurate understanding thereof.

Similarly, to the empiricist, "the successful applicability of arithmetic in physics is an intellectual embarrassment" (Hoppe, "On Praxeology and the Praxeological Foundations of Epistemology: Sec. III"). Hoppe explains that the key to arithmetic is repetition – a repetition of a given action. In order to count an object, one must act. In order to count yet another object of the same type, one must act again in a manner fundamentally similar to the last. Arithmetic refers to an action being repeated in this manner as having been done *twice*; since the action referred to distinct entities – and each repetition of the action counted one entity – arithmetic can say that *two* entities were registered via the counting procedure. The existence of action can be arrived at *a priori*. Because it is possible to repeat a given action in reality, the counting numbers – the foundation of arithmetic – must, too, be examples of true synthetic *a priori* knowledge.

Hoppe claims that a consistent empiricist would seek "to establish the theorem of Pythagoras by actually measuring sides and angles of triangles. Just as anyone would have to comment on such an endeavor, mustn't we say that to think economic propositions would have to be empirically tested is a sign of outright intellectual confusion?" ("Praxeology and Economic Science: Sec. I"). The empirical testing of the Pythagorean Theorem would be absurd because Euclidean geometry is both *a priori* true and remarkably successful: its insights can be perfectly applied to engineering and construction. The validity of geometry, too, follows from the existence of human action, since "[a]ction is the employment of a physical body in space" (Hoppe, "Praxeology and Economic Science: Sec. II"). The ultimate standard of measurement is the manner in which the human body exists and moves spatially. These positions and movements can be analyzed in terms of simpler components: points, lines, and planes. To measure these spatial properties, humans can create instruments on the basis of the ubiquitously known manner in which the body exists and moves in order to act. No specific measurement or observation can ever refute the validity of Euclidean standards of measurement: the standards are what make measurement itself possible. Euclidean geometry "is not only the very precondition for any empirical spatial description, it is also the precondition for any active orientation in space" (Hoppe, "On Praxeology and the Praxeological Foundations of Epistemology: Sec. III"). If the standards of Euclidean geometry were not valid and perfectly accurate in describing reality, the human body as a three-dimensional entity would not be able to exist and relate to other three-dimensional entities.

The axioms of Euclidean geometry correspond to the physical world, whereas the axioms of geometric systems contrary to Euclid's do not, unless confined to some specific applied context and used strictly as limited tools within that context. (That is, they are not true axioms, since they can be elementarily refuted in the course of ubiquitous daily observation.) The human body can be measured by using three and only three spatial parameters – known as dimensions: any system of measurement claiming more or less than three dimensions will fail to adequately describe man's physical form. All parts of the human body have boundaries, describing which necessitates the Euclidean constructs of points, lines, and planes. Furthermore, all human movement and interaction with other entities occurs three-dimensionally. Every possible path of motion can be described by adding three mutually perpendicular vectors of the proper magnitudes. Moreover, all spatial measuring instruments can only be built with Euclidean postulates at the foundation of their design:

> "Euclidean geometry... is no more and no less than the reconstruction of the ideal norms underlying our construction of such homogeneous basic forms as points, lines, planes and distances, which are in a more or less perfect but always perfectible way incorporated or realized in even our most primitive instruments of spatial measurements such as a measuring rod. " (Hoppe, "On Praxeology and the Praxeological Foundations of Epistemology: Sec. III")

No measurement can ever refute the validity of Euclidean geometry, since measuring tools themselves – as well as the bodies and movements of those who measure – are predicated upon the axioms of Euclid's system. If the spatial qualities of humans and *all* the objects they observe and interact with can be described and measured only through Euclid's system, there is no point in asserting that any non-Euclidean geometry can also be universally true, since the Euclidean system can describe everything that exists.

Empiricism denies the possibility of certain knowledge because it ignores the existence of human action. Empiricists systematically deride the valid and *empirically successful* branches of a priori knowledge – praxeology, logic, arithmetic, and Euclidean geometry – as meaningless formalisms devoid of actual information about reality. In so doing, the empiricists implicitly erect an impregnable barrier between the mind and reality. According to them, if X is a fact of reality, it cannot be conclusively grasped by the mind; if X was derived by the mind, it cannot be relevant to reality. The empiricists can claim this only by disregarding man's identity as an acting being with a mind that exists and acts in reality. The mind of an agent in reality must *necessarily* have access to the external world and the capacity to comprehend existence by means of reason. This access implies the mind's ability to derive certain, irrefutable, unfalsifiable knowledge about its own nature and the nature of the world with which it interacts.

Refutation of Historicism

The insights of praxeology allow us to disprove another doctrine that denies the possibility of certain, objective economic knowledge: historicism. Hoppe describes historicism as the belief that economic events "are subjective expressions and interpretations unfolding in history to be understood and interpreted by the economist just as a literary text unfolds before and is interpreted by its reader" (Hoppe, "Praxeology and Economic Science: Sec. II"). To the

historicist, no absolute, universal economic laws exist. All that exists is a set of past economic data as incorporated into historical texts. No past economic event occurred because it *necessarily* had to – as derived from insights into the nature of human action – but rather the events happened simply because they did. What is true for one historical era might not be true for another. The free market, according to the historicists, might have worked in the 19th century, but it does not necessarily have to work today – nor would even basic economic principles, such as the law of diminishing marginal utility, have to be permanent, immutable, or universally applicable. To the historicist, there is not only no certain knowledge about the economic principles behind historical events – there is also no certain knowledge even about *what historical events actually happened.* Since historical economic events are not constrained by any universally valid laws, there is no way to objectively interpret and gain genuine knowledge from them:

> "[T]he formation of these always contingently related human expressions and their interpretations is also not constrained by any objective law... [H]istorical and economic events are whatever someone expresses or interprets them to be, and their description by the historian and economist is then whatever he expresses or interprets these past subjective events to have been." (Hoppe, "On Praxeology and the Praxeological Foundations of Epistemology: Sec. II")

To the historicist, both history and economics ultimately become whatever a given historian or economist chooses to turn them into, with no definitive criterion of truth and falsity to verify or disprove a given economic theory. Mises was perhaps too generous to write that "[h]istoricism aim[s] at replacing [economics] by economic history..." (4). Rather, historicism replaces *both* economics *and* history with the historicist's unsubstantiated wishes concerning what each discipline *ought to have been.* Hoppe describes the unscientific result: the historicist's "output takes on the form of disquisitions on what someone feels about what he feels was felt by somebody else" ("On Praxeology and the Praxeological Foundations of Epistemology: Sec. II").

The fundamental premise of historicism can be refuted in a similar manner to the fundamental premise of empiricism. Historicism claims that there are no permanent, constant economic laws transcending a given era and location. That premise itself, however, is held by the historicists to be a constant and time-invariant relation. That is, we cannot say of *any* era and location that its economic events follow a universally applicable, logically deducible set of laws. The historicist is faced with two alternatives. Either he admits that his basic premise constitutes a time-invariant relation, whereby he implicitly rejects historicism's blanket denial of such relations and concedes the possibility of *a priori*, logical, universally valid economics. Or he denies that this premise is a time-invariant relation, which means that we can *never ascertain its absolute truth.* Historicism can be true for one era, but not for another – and does not *have* to be true for any era. Hoppe describes the sorry state the historicist premise would attain under such an assumption: "it may be true now, if we wish it so, yet possibly false a moment later, in case we do not, with no one ever knowing anything about whether we do or do not" ("On Praxeology and the Praxeological Foundations of Epistemology: Sec. II"). If the historicist premise – under a consistent application of historicism – can possibly be false, that, too, leaves open the possibility of using logical, *a priori* methods for arriving at economic truths.

Moreover, the analysis of historical data alone is sufficient in obtaining *any* understanding of economics. According to Hoppe, "observational evidence can only reveal things as they happen to be; there is nothing in it that would indicate why things *must* be the way they are" ("On Praxeology and the Praxeological Foundations of Epistemology: Sec. II"). When we examine a succession of economic statistics or an account of who traded with whom or what government policies correlated with what effects on industry – we only know *that* given events happened. We cannot, from sheer observation, know *why* they happened; we cannot have any comprehensive understanding of causality, since causality is a category of action. All we can effectively understand from observing historical data alone is what physical movements individuals happened to make in a given time and place. In order to form any meaningful *theory* that accurately *interprets* the historical events, man must *introspect* and *reflect upon* those events using the methods available to his rational faculty. There is no way to interpret historical events if one conceives of them as mere meaningless, contingent physical movements. The movements must be analyzed within the framework of *action*: the economist knows that the events are actions because he, too, is an acting being, and his mind is linked to reality via his status as such. As soon as one concedes that historical events are actions, the entire body of propositions derivable from that fact – indeed, the whole science of praxeology – can be applied to them.

Only the logical, *a priori* methods of praxeology can reveal any meaning to historical economic events. For example, let us presume that in year X the government of a country set an artificial ceiling on the price of widgets. A shortage of widgets occurred. However, in year Y, the government established a similar ceiling and no shortage took place. The historicist would hasten to claim that we cannot know with certainty that government price ceilings have negative effects: after all, in year Y, no shortage happened. Only the methods of praxeology could show the historicist that a government price ceiling is *always* detrimental under a given set of conditions – namely, when the government tries to restrict a good's price below the market equilibrium.

The praxeologist would know that the widget shortage did not occur only because of the positive influence of *some other factor* besides the price ceiling. In year Y, the widget manufacturers' technological capacity increased, independent of the government price ceiling, to enable them to mass-produce widgets on a scale previously impossible. The shift in technological capacity happened to occur at the same time as the government was in the process of imposing its price ceiling. However, because of the increased supply of widgets from mass production, the equilibrium price of widgets was pushed *below* the government price ceiling; hence, the restriction was plainly irrelevant to the widget price: it was tantamount to the government forbidding anyone to charge more than $500 for a bottle of milk. This particular historical event does not negate the universal truth that, whenever the government artificially pushes a good's price *below market equilibrium,* shortages will result, since the number of goods consumers demand at the lower price will exceed the number of goods producers are willing to supply at that price. The praxeological insight concerning the origin of shortages does not require the analysis of an open set of historical data in order to be validated with certainty; all one needs to know is the nature of supply, demand, and market equilibrium, arrived at via the action axiom. However, once understood, the praxeological truth can be applied to *any* relevant historical event and give the economist certain, irrefutable knowledge about it. Unlike historicism, which seeks to negate the objective truth of both economics and history, praxeology renders the study of both disciplines meaningful and crucial to man's understanding of reality.

Conclusion

We have demonstrated how praxeology, the science of human action, affirms the validity of an entire *type* of human knowledge, synthetic *a priori* truths, without which cognition of reality would be unattainable. The action axiom, the starting point of praxeology, is also an indispensable link between reason and observation, for humans have the minds of entities acting in the absolute reality. By means of the insight that humans act, the study of an entire array of disciplines – logic, epistemology, arithmetic, geometry, economics, and history (when analyzed with the help of praxeology) – can be demonstrated as useful and capable of imparting certain, irrefutable, unfalsifiable knowledge. Furthermore, two principal doctrines, empiricism and historicism, which deny the possibility of irrefutable knowledge have been shown to be false, contradictory, and absurd. The logical errors in both doctrines implicitly concede the possibility and validity of *a priori* economic analysis and *a priori* knowledge in general.

NOTE: This essay is my attempt to describe the manner in which the fundamentals of Austrian economic thought affirm man's ability to know this world through his rational faculty. Hence, I seek to represent the Austrian view and its implications as accurately as I can – which involves using terms and concepts which I might not necessarily use myself. Unlike Ludwig von Mises, I do not adhere to Kantian epistemology and do not believe in the synthetic-analytic dichotomy. However, I acknowledge that Misesian contributions to Kantian epistemology render the latter less flawed than it otherwise would have been. Mises and his intellectual successors recognize what many Kantians and post-Kantians did not: the existence of synthetic *a priori* true propositions – which serve as the crucial link between reason and observation. A thinker who rejects the synthetic-analytic dichotomy can simply refer to such propositions as *axioms* (or the derivatives of axioms). "Axioms/axiom-derivatives" and "synthetic *a priori* true propositions" are, for all real purposes, identical designations. Aside from this slight epistemological clarification, I fully endorse the endeavor of praxeology in its analysis of human action *qua* action and this idea's implications.

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Progress for Physics: New Model of Loop Quantum Cosmology Rejects Singularities and Affirms Insights in A Rational Cosmology

In an excellent step forward for mainstream theoretical physics, the model of Loop Quantum Cosmology (LQC) presents a picture of a universe where singularities do not exist. LQC still holds that a Big Bang happened, but the Big Bang was not the beginning of existence itself,

unlike conventional contemporary mainstream cosmology asserted. Rather, according to LQC, the Big Bang occurred after a prior "universe" collapsed and all the entities in it came to occupy an extremely small volume – but not an *infinitely* small one. The New Scientist article, "Did our cosmos exist before the Big Bang?" (published December 10, 2008) by Anil Ananthaswamy, describes LQC in a manner accessible to the layman reader.

LQC, originated by Ashtekar, Singh, Pawlowski, and Bojowald, is a wonderful improvement in clarity and logical consistency over conventional cosmology. It also affirms many of the insights present in my treatise, *A Rational Cosmology.*

LQC does not treat "the universe" as all of existence; rather, it refers to the "present universe" as all of existence after the Big Bang, and to some "past universe" as all of existence *prior* to the Big Bang. Thus, LQC holds that there was not necessarily an act that created existence itself. This is a different definition of "universe" from the one I used in *A Rational Cosmology* (where I defined the "universe" as "everything that exists"). However, it is a definition that is logically consistent with what I have been saying all along: that *existence itself* could not have been created – although some *subset* of existence may have had a beginning.

According to Mr. Ananthaswamy's article, here is a picture of existence that LQC would imply: "*If [LQC's predictions are] verified, the big bang will give way to a big bounce and we will finally know the quantum structure of space-time. Instead of a universe that emerged from a point of infinite density, we will have one that recycles, possibly through an eternal series of expansions and contractions, with no beginning and no end*."

While I am still quite skeptical that *every entity in existence* can act in this highly coordinated manner with respect to every other entity, this theory is at least logically conceivable, and if a plausible spontaneous-order mechanism for such coordination can be presented, I am willing to accept it. LQC eliminates two fatal flaws from mainstream contemporary cosmology:

(1) The idea that all of existence could have been created, instead of existence always existing. This is fundamentally a religious notion and not a scientific one; it implies creation *ex nihilo* and has no place in a rational worldview.

(2) The idea that the universe or "our present universe" at one time existed as a single point of infinite density – namely, a singularity. According to the article, "*Bojowald's major realisation was that unlike general relativity, the physics of LQC did not break down at the big bang. Cosmologists dread the singularity because at this point gravity becomes infinite, along with the temperature and density of the universe. As its equations cannot cope with such infinities, general relativity fails to describe what happens at the big bang. Bojowald's work showed how to avoid the hated singularity, albeit mathematically… Singh and Pawlowski developed computer simulations of the universe according to LQC, and that's when they saw the universe bounce. When they ran time backwards, instead of becoming infinitely dense at the big bang, the universe stopped collapsing and reversed direction. The big bang singularity had truly disappeared*."

I have been arguing these two points since 2005, and have often been ridiculed by conventionally minded people for defying the scientific "consensus". Well, it seems that there is no longer such

a consensus and that the thrust of new scientific theory is in fact highly consistent with many, even if not all, of my philosophical writings on cosmology. Here are some excerpts from my treatise, precisely on these subjects. Keep in mind that the impossibility of creation *ex nihilo* and singularities were *my primary objections* to conventional Big Bang theory.

From Essay VII:

"Assuming that a singularity was a single entity, which exploded to result in the Big Bang, what caused the explosion? Explosion, like generic creation, is an action, and an action is a relationship of multiple entities that results in the alteration of said entities' qualities."

"…If the singularity were the only entity that existed, and had no component parts that could interact amongst one another, it could not have exploded, nor could it have *acted in any way whatsoever*!"

"…if the entity is some single, monolithic, component-less, indivisible thing, such as the Big Bang theory's definition of a singularity, and it happens to have certain qualities at a given time (such as non-explosivity, for example), and no other entity exists to change these qualities, there is no way that these qualities can be changed! A thing is what it is, and cannot, especially if it lacks volition, *spontaneously decide* to become something else and assume a different totality of qualities."

"If such a component-less entity as a singularity were left *entirely unto itself,* nothing could have influenced a change in its quality of non-explosivity, and it could not have exploded. Without any mechanism to induce an alteration in its qualities, it would have remained just what it was, a singularity."

From Essay XIV:

"if the quality 'matter' exists in an entity, it must have a real manifestation; this manifestation is volume. If the quality 'matter' and the quality 'volume' did not coexist and were not inextricably connected, we would encounter absurdities."

From Essay XV:

"A singularity conceived of as a sole point containing mass, but mass without volume – i.e., a point-entity – is a contradiction in terms."

In the words of Ayn Rand, "*an error made on your own is safer than ten truths accepted on faith, because the first leaves you the means to correct it, but the second destroys your capacity to distinguish truth from error*" ("Introduction," *The Virtue of Selfishness*). In the true spirit of the individualism that Rand advocates, I held to my own reasoning and my own understanding of cosmology, *in spite* of what the prevailing consensus among the laymen and scientists of my time was. I did not take *any* understanding on faith, irrespective of how prestigious or "indisputable" the theory endorsing it was. On this issue at least, future scientists will likely agree that I was right after all.

Hořava Gravity Theory Overturns Einsteinian Spacetime and Vindicates Aspects of A Rational Cosmology

Why Ubiquitous Observation and Valid Scientific Theories Must Be Consistent

Mainstream physics is in the midst of a welcome development, as a new theory by Petr Hořava has posed a serious challenge to Einstein's General Relativity model. Einstein posited an equivalence in kind between time and space and rejected the Newtonian view of time as absolute. In *A Rational Cosmology*, particularly in Chapter IV, I showed that this view is logically impossible and that the absolutism of time is required for the concept of time to be meaningful.

The article "Splitting Time from Space - New Quantum Theory Topples Einstein's Spacetime" in Scientific American (published November 24, 2009) is a vindication of this philosophical view. Dr. Hořava's theory, by reverting to a Newtonian view of space and time, resolves a lot of the oddities and inconsistencies between quantum mechanics and gravity. The theory also eliminates the logically impossible notion of a "singularity" or of the universe ever having been or fated to become a single dimension-less point. What is even more remarkable is that the theory is being received with considerable respect, and scientists throughout the world are finding empirical data to be consistent with it. The article is well worth a read.

I am not advocating the entirety of Dr. Hořava's theory as Truth. Indeed, one of the marks of the specific-observational sciences, such as physics, is the continual evolution of models that offer increasingly more predictive and accurate explanations of the behaviors of real-world objects. Aspects of this theory may well be inconsistent with some data and may be falsified in the future. As the theory relies on the dubious notion of the graviton, which I examined in Essay LXII of *A Rational Cosmology*, it is likely to eventually diverge from reality. However, it, like Loop Quantum Cosmology, is a clear improvement over the orthodox mess of contradictions that preceded it. As such, Dr. Hořava deserves to be praised as a brilliant innovator and an important contributor to the progress of human knowledge.

The more physics progresses – and it *is* progressing today, despite any cynicism I might have about the mindsets of some advocates of cosmological orthodoxy – the more findings emerge to vindicate my philosophical insights in *A Rational Cosmology*, insights which pose radical and fundamental challenges to the crumbling orthodoxy in the *philosophical* interpretation of physics. *A Rational Cosmology* is not, and does not pretend to be, a work of physics. It is rather a work of *philosophy* that attempts to make sense of our ubiquitous observations of the world around us, in a framework of rigorous logic and reliance on the evidence of our senses. The vital principle where the search for truth is concerned is that *no true aspect of reality will ever contradict any other true aspect of reality.* Therefore, what we know about the world through our everyday sensory experiences and logical deductions *must* be consistent with our specific theories about any aspect of reality – including theories applicable to both the natural sciences and the social sciences. If a theory's interpretation contradicts the evidence of our senses and our

reason, then it is that interpretation which must be wrong – although the *mathematics* behind the theory may still be correct and have considerable predictive power.

Dr. Hořava's Quantum Gravity theory has made it possible for mainstream physicists to seriously question Einsteinian spacetime, the relativity of time, singularities, and the creation/destruction view of the universe. This is serious progress. Perhaps soon, more questions will be posed – and more rational solutions will be developed. As we look forward to the future of physics (and of philosophy), it will behoove us to consult not only our reason and our senses, but also the minds of past great innovators, such as Sir Isaac Newton, whose insights still facilitate new discoveries today.

Philosophy Lives – Contra Stephen Hawking

In his 2010 book *The Grand Design*, cosmologist and theoretical physicist Stephen Hawking writes that science has displaced philosophy in the enterprise of discovering truth. While I have great respect for Hawking both in his capacities as a physicist and in his personal qualities – his advocacy of technological progress and his determination and drive to achieve in spite of his debilitating illness – the assertion that the physical sciences can wholly replace philosophy is mistaken. Not only is philosophy able to address questions outside the scope of the physical sciences, but the coherence and validity of scientific approaches itself rests on a philosophical foundation that was not always taken for granted – and still is not in many circles.

Hawking writes, "*Living in this vast world that is by turns kind and cruel, and gazing at the immense heavens above, people have always asked a multitude of questions: How can we understand the world in which we find ourselves? How does the universe behave? What is the nature of reality? Where did all this come from? Did the universe need a creator? Most of us do not spend most of our time worrying about these questions, but almost all of us worry about them some of the time. Traditionally these are questions for philosophy, but philosophy is dead. Philosophy has not kept up with modern developments in science, particularly physics. Scientists have become the bearers of the torch of discovery in our quest for knowledge.*"

I hesitate to speculate why Hawking considers philosophy to be "dead" – but perhaps this view partly arises from frustration at the non-reality-oriented teachings of many postmodernist philosophers who still prevail in many academic and journalistic circles. Surely, those who deny the comprehensibility of reality and allege that it is entirely a societal construction do not aid in the quest for discovery and understanding of what really exists. Likewise, our knowledge cannot be enhanced by those who deny that there exist systematic and specific methods that are graspable by human reason and that can be harnessed for the purposes of discovery. It is saddening indeed that prominent philosophical figures have embraced anti-realist positions in metaphysics and anti-rational, anti-empirical positions in epistemology. Physicists, in their everyday practice, necessarily rely on external observational evidence and on logical deductions from the empirical data. In this way, and to the extent that they provide valid explanations of natural phenomena, they are surely more reality-oriented than most postmodernist philosophers. Yet philosophy does not need to be this way – and, indeed, philosophical schools of thought throughout history and in the present day are not only compatible with the scientific approach to reality, but indispensable to it.

Contrary to the pronouncements of prominent postmodernists, a venerable strain of thought – dating back to at least Aristotle and extending all the way to today's transhumanists, Objectivists, and natural-law thinkers – holds that an objective reality exists, that it can be understood through systematic observation and reason, and that its understanding should be pursued by all of us. This is the philosophical strain responsible for the accomplishments of Classical Antiquity and the progress made during the Renaissance, the Enlightenment, the Industrial Revolution, and the Information Revolution. While such philosophy is not the same as the physical sciences, the physical sciences rely on it to the extent that they embrace the approach known as the scientific method, which itself rests on philosophical premises. These premises include the existence of an external reality independent of the wishes and imagination of any observer, the existence of a definite identity of any given entity at any given time, the reliance on identical conditions producing identical outcomes, the principles of causation and non-contradiction, and the ability of human beings to systematically alter outcomes in the physical world by understanding its workings and modifying physical systems accordingly. This latter principle – that, in Francis Bacon's words, "Nature, to be commanded, must be obeyed" – was the starting point for the Scientific Revolution of the 17th Century, which inaugurated subsequent massive advances in technology, standards of living, and human understanding of the universe. Even those scientists who do not acknowledge or explicitly reject the importance of philosophy nonetheless implicitly rely on these premises in the very conduct of their scientific work – to the extent that such work accurately describes reality. These premises are not the only ones possible – but they are the only ones that are fully right. Alternatives – including reliance on alleged supernatural revelation, wishful thinking, and unconditional deference to authority – have been tried time and again, only to result in stagnation and mental traps that prevented substantive improvements to the human condition.

But there is more. Not only are the physical sciences without a foundation if philosophy is to be ignored, but the very reason for pursuing them remains unaddressed without the branch of philosophy that focuses on what we *ought* to do: ethics. Contrary to those who would posit an insurmountable "is-ought" gap, ethics can indeed be derived from the facts of reality, but not solely by the tools of physics, chemistry, biology, or any others of the "hard" physical sciences. An additional element is required: the fact that *we ourselves* exist as rational, conscious beings, who are capable of introspection and of analysis of external data. From the physical sciences we can derive ways to sustain and improve our material well-being – sometimes our very survival. But only ethics can tell us that we *ought* to pursue such survival – a conclusion we reach through introspection and logical reasoning. No experiment, no test is needed to tell us that we ought to keep living. This conclusion arises as antecedent to a consistent pursuit of any action at all; to achieve any goal, we must be alive. To pursue death, the opposite of life, contradicts the very notion of acting, which has life as a prerequisite. Once we have accepted that premise, an entire system of logical deductions follows with regard to how we ought to approach the external world – the pursuit of knowledge, interactions with others, improvement of living conditions, protection against danger. The physical sciences can provide many of the empirical data and regularities needed to assess alternative ways of living and to develop optimal solutions to human challenges. But ethics is needed to keep the goals of scientific study in mind. The goals should ultimately relate to ways to enhance human well-being. If the pursuit of human well-being – consistent with the imperative of each individual to continue living – is abandoned, then the physical sciences alone cannot provide adequate guidance. Indeed, they can be utilized to

produce horrors – as the development of nuclear weapons in the 20th century exemplified. Geopolitical considerations of coercive power and nationalism were permitted to overshadow humanistic considerations of life and peace, and hundreds of thousands of innocents perished due to a massive government-sponsored science project, while the fate of human civilization hung in the balance for over four decades.

The questions cited by Hawking are indeed philosophical questions, at least in part. Aspects of these questions, while they are broadly reliant on the existence of an objective reality, do not require specific experiments to answer. Rather, like many of the everyday questions of our existence, they rely only on the ubiquitous inputs of our day-to-day experience, generalized within our minds and formulated as starting premises for a logical deductive process. The question "*How can we understand the world in which we find ourselves?*" has different answers based on the realm of focus and endeavor. Are we looking to understand the function of a mechanism, or the origin of a star? Different tools are required for each, but systematic experimentation and observation would be required in each case. This is an opening for the physical sciences and the scientific method. There are, however, ubiquitous observations about our everyday world that can be used as inputs into our decision-making – a process we engage in regularly as we navigate a room, eat a meal, engage in conversation or deliberation, or transport any object whatsoever. Simply as a byproduct of routine living, these observations provide us with ample data for a series of logical deductions and inferences which do not strictly belong to any scientific branch, even though specific parts of our world could be better understood from closer scientific observation.

The question "*How does the universe behave?*" actually arises in part from a philosophical presupposition that "the universe" is a single entity with any sort of coordinated behavior whatsoever. An alternative view – which I hold – is that the word "universe" is simply convenient mental shorthand for describing the totality of every single entity that exists, in lieu of actually enumerating them all. Thus, while each entity has its own definite nature, "the universe" may not have a single nature or behavior. Perhaps a more accurate framing of that question would be, "What attributes or behaviors are common to all entities that exist?" To answer that question, a combination of ubiquitous observation and scientific experimentation is required. Ubiquitous observation tells us that all entities are material, but only scientific experimentation can tell us what the "building blocks" of matter are. Philosophy alone cannot recommend any model of the atom or of subatomic particles, among multiple competing non-contradictory models. Philosophy can, however, rightly serve to check the logical coherence of any particular model and to reject erroneous interpretations of data which produce internally contradictory answers. Such rejection does not mean that the data are inaccurate, or even that a particular scientific theory cannot predict the behavior of entities – but rather that any verbal understanding of the accurate data and predictive models should also be consistent with logic, causation, and everyday human experience. At the very least, if a coherent verbal understanding is beyond our best efforts at present, philosophy should be vigilant against the promulgation of *incoherent* verbal understandings. It is better to leave certain scientific models as systems of mathematical equations, uncommented on, than to posit evidently false interpretations that undermine laypeople's view of the validity of our very existence and reasoning.

After all – to return to the ethical purpose of science – one major goal of scientific inquiry is to understand and explain the world we live in and experience on a daily basis. If any scientific model is said to result in the conclusion that our world does not 'really' exist or that our entire experience is illusory (rather than just occasional quirks in our biology, such as those which produce optical illusions, misleading us, in an avoidable manner, under specific unusual circumstances), then it is the philosophical articulation of that model that is flawed. The model itself may be retained in another form – such as mathematical notation – that can be used to predict and study phenomena which continue to defy verbal understanding, with the hope that someday a satisfactory verbal understanding will be attained. Without this philosophic vigilance, scientific breakthroughs may be abused by charlatans for the purpose of misleading people into ruining their lives. As a prominent example of this, multiple strains of mysticism have arisen out of bad philosophical interpretations of quantum mechanics – for instance, the belief, articulated in such pseudo-self-help books as *The Secret*, that people can mold reality with their thoughts alone and that, instead of working hard and thinking rationally, they can become immensely wealthy and cure themselves of cancer just by wanting it enough. Without a rigorous philosophical defense of reason and objective reality, either by scientists themselves or by their philosopher allies, this mystical nonsense will render scientific enterprises increasingly misunderstood by and isolated from large segments of the public, who will become increasingly superstitious, anti-intellectual, and reliant on wishful thinking.

The question "*What is the nature of reality?*" is a partly philosophical and partly scientific one. The philosophical dimension – metaphysics – is needed to posit that an objective, understandable reality exists at all. The scientific dimension comes into play in comprehending specific real entities, from stars to biological organisms – relying on the axioms and derivations of metaphysics for the experimental study of such entities to even make sense or promise to produce reliable results. Philosophy cannot tell you what the biological structure of a given organism is like, but it can tell you that there is one, and that praying or wishing really hard to understand it will not reveal its identity to you. Philosophy can also tell you that, in the absence of external conditions that would dramatically affect that biological structure, it will not magically change into a dramatically different structure.

The questions "*Where did all this come from? Did the universe need a creator?"* are scientific only to a point. When exploring the origin of a particular planet or star – or of life on Earth – they are perfectly amenable to experimentation and to extrapolation from historical evidence. Hence, the birth of the solar system, abiogenesis, and biological evolution are all appropriate subjects of study for the hard sciences. Moreover, scientific study can address the question of whether a particular object needed to have a creator and can, for instance, conclude that a mechanical watch needed to have a watchmaker, but no analogous maker needed to exist to bring about the structure of a complex biological organism. However, if the question arises as to whether existence itself had an origin or needed a creator, this is a matter for philosophy. Indeed, rational philosophy can point out the contradiction in the view that existence itself could ever not have existed, or that a creator *outside of existence* (and, by definition, non-existent at that time) could have brought existence into being.

Interestingly enough, Hawking comes to a similar conclusion – that cosmological history can be understood by a model that not include a sentient creator. I am glad that Hawking holds this

view, but this specific conclusion does not require theoretical or experimental physics to validate; it simply requires a coherent understanding of terms such as “existence”, “universe”, and “creator”. Causation and non-contradiction both preclude the possibility of any *ex nihilo* creation. As for the question of whether there exist beings capable of vast cosmic manipulations and even the design of life forms – that is an empirical matter. Perhaps someday such beings will be discovered; perhaps someday humans will themselves become such beings through mastery of science and technology. The first steps have already been taken – for instance, with Craig Venter’s design of a synthetic living bacterium. Ethics suggests to me that this mastery of life is a worthwhile goal and that its proponents – transhumanists – should work to persuade those philosophers and laypeople who disagree.

More constructive dialogue between rational scientists and rational philosophers is in order, for the benefit of both disciplines. Philosophy can serve as a check on erroneous verbal interpretations of scientific discoveries, as well as an ethical guide for the beneficial application of those discoveries. Science can serve to provide observations and regularities which assist in the achievement of philosophically motivated goals. Furthermore, science can serve to *disconfirm* erroneous philosophical positions, in cases where philosophy ventures too far into specific empirical predictions which experimentation and targeted observation might falsify. To advance such fruitful interactions, it is certainly not productive to proclaim that one discipline or another is “dead”. I will be the first to admit that contemporary philosophy, especially of the kind that enjoys high academic prestige, is badly in need of reform. But such reform is only possible after widespread acknowledgment that philosophy does have a legitimate and significant role, and that it can do a much better job in fulfilling it.

About G. Stolyarov II

G. Stolyarov II is an actuary, libertarian transhumanist philosopher, science-fiction novelist, poet, amateur mathematician, composer, and Editor-in-Chief of The Rational Argumentator, a magazine championing the principles of reason, rights, and progress. Mr. Stolyarov is a contributor to Le Quebecois Libré, Rebirth of Reason, Transhumanity.net, Enter Stage Right, the Institute for Ethics and Emerging Technologies, and the Ludwig von Mises Institute. Mr. Stolyarov also publishes his articles on the Yahoo! Contributor Network to assist the spread of rational ideas. He holds the highest Clout Level (10) possible on the Yahoo! Contributor Network and is one of its Page View Millionaires, with over 2 million views. Mr. Stolyarov regularly produces YouTube Videos discussing life extension, libertarianism, and related subjects.

Mr. Stolyarov holds the professional insurance designations of Associate of the Society of Actuaries (ASA), Associate of the Casualty Actuarial Society (ACAS), Member of the Academy of Actuaries (MAAA), Chartered Property Casualty Underwriter (CPCU), Associate in Reinsurance (ARe), Associate in Regulation and Compliance (ARC), Associate in Personal Insurance (API), Associate in Insurance Services (AIS), Accredited Insurance Examiner (AIE), and Associate in Insurance Accounting and Finance (AIAF). The views expressed in this work are entirely his own and should not be construed as the views of any organization.