A Retraction of *The Cosmic Sphere*

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Abstract: In a 1999 book entitled *The Cosmic Sphere*, the author proposed an unconventional model of the Universe intended to solve conceptual and empirical problems facing the Big Bang theory. The author has since had second thoughts, however, and has concluded that his proposed Cosmic Sphere Model (CSM) of the Universe is flawed and cannot be accurate. In this article, the author provides an overview of *The Cosmic Sphere* and CSM, points out the errors of both, analyzes the implications of the errors, and closes with a few words about a future philosophical publication on cosmology.

1. About *The Cosmic Sphere*

The Cosmic Sphere was my first book on the subject of *cosmology* [1]. Cosmology is the scientific and philosophical study of the Cosmos—the Universe as an orderly system. Cosmology proposes and studies conceptual models designed to explicate or explain the underlying order to the nature, structure, development, origin, and terminus of the Universe. Cosmology has historically been a subfield of both philosophy and science, but since 1960 science has dominated the study of cosmology [2]. Even so, scientific cosmology rests on philosophical assumptions and philosophy still offers cosmological speculations informed by the latest science. *The Cosmic Sphere* was intended as the latter kind of work—a philosophical cosmology based on the latest science.

The scientific community is in general agreement on the most accurately devised model of the Cosmos, which is known as the *standard model of cosmology* or simply the *standard cosmology*. According to the standard cosmology, the Universe is made of ordinary matter, *cold dark matter* (invisible, electrically neutral stuff), and *dark energy* (a kind of antigravity often denoted by the Greek capital letter Lambda, or Λ). Consequently, the standard cosmology is often known as the Lambda Cold Dark Matter Model, Lambda-CDM, or ΛCDM. Most cosmologists and astrophysicists now assume that, in order to be credible, any new cosmological or astrophysical theory must be "in concordance with" ΛCDM. Because of that standard, scientists in the field also refer to ΛCDM as the *concordance model of cosmology* or simply the *concordance cosmology*.

The Cosmic Sphere was written in the late 1990s, at a time when the standard cosmology was known in common parlance as the Big Bang theory (or the Big Bang model of cosmology). According to the Big Bang theory, the Universe is on extragalactic scales expanding and cooling from an initial 'Big Bang' event or epoch that occurred before the formation of the first stars and galaxies. The Big Bang theory was originally about how the Universe began, how it is structured, and how it evolves. But in recent years the Big Bang has become a theory *only* about how the Universe began while the standard cosmology—now the 'concordance' cosmology—is more about what the Universe is made of and how it changes over time rather than about how it began. The concordance cosmology still *assumes* a Big Bang took place, but it does not emphasize study of it per se since concerns about the Universe's origin are regarded as a separate issue from concerns about how the Universe is structured and evolves subsequent to its origin [3].

Despite their successes, the concordance cosmology and the Big Bang theory still have conceptual and empirical problems unresolved since *The Cosmic Sphere* was written. In the book, I presented a new, unconventional model of the Cosmos intended to solve those problems—or at least point to their solution. The new model of the Cosmos I proposed was called the Cosmic Sphere Model (CSM); hence the book's title.

Being unconventional, CSM did not assume the Big Bang, dark matter, or dark energy to account for astronomical observations. Instead, CSM was an unconventional model of space, time, and motion. More precisely, CSM was a *nonstandard cosmology* based on some novel proposals about space, time, and motion along with some *dissident physics* in support of that proposal.

To ensure a common understanding of these terms, here are a few definitions:

- **standard cosmology:** *the most accurately devised model of the Cosmos to date according to the current consensus of the scientific community*. (Also known as the *standard model of cosmology*, the *concordance model*, or the *concordance cosmology*).
- **nonstandard cosmology:** *any proposed model of the Cosmos that contradicts the standard (concordance) cosmology*.
- **dissident physics:** *any physics conjecture, model, or method that dissents from mainstream scientific consensus on subjects pertaining to physics.*
- **dissident physicist:** *anyone practicing or proposing dissident physics*.

CSM was a nonstandard cosmology that also assumed some dissident physics conjectures.

The Cosmic Sphere Model

The concordance cosmology is incomplete without a theory of *quantum gravity* [4] that dissolves the contradictions between two accepted theories of physics—*relativity* and *quantum mechanics* [5]. According to relativity, space and time are a single *spacetime* entity that continually changes in its geometry relative to differences among the masses of material bodies and the states of motion among observers. By contrast, quantum mechanics portrays space and time as each separate entities that remain fixed in their measurements, thus providing an absolute background—the same for all observers and masses. If space and time are relative, then they are not absolute and if they are absolute then they are not relative—hence, a contradiction between relativity and quantum mechanics [6]. Theoretical physicists offer various versions of quantum gravity intended to dissolve these contradictory views of space and time [7].

From when I wrote *The Cosmic Sphere* to the date of this article's posting, the two most popular versions of quantum gravity are *supersymmetric string theory* (also called *superstring theory* or just *string theory* for short) and *loop quantum gravity* [8]. Each of these versions of quantum gravity is a different approach for deconflicting the relativistic and quantum mechanical portrayals of space and time.

In string theory, relativity's gravitational fields are the effect of quantum particles called *gravitons*—each of which is shaped like a vibrating rubber band or closed loop of 'string' that moves from one mass to another at the speed of light through a fixed background of higher dimensional spaces too small to detect. According to loop quantum gravity, relativity's spacetime is also quantized into discrete units too small to detect, but with each of those units dynamically interacting with the others to produce continuous gravitational fields on macroscopic scales [9].

If either string theory or loop quantum gravity is successful in reconciling relativity and quantum mechanics, such would further support the likelihood of the concordance cosmology as an accurate model of physical reality since the model contains assumptions resting on both relativity and quantum mechanics [10]. However, neither string theory nor loop quantum gravity is confirmed and it is highly doubtful they can even be empirically tested in any kind of unambiguous manner since they each posit entities too small to detect.

Although I was intrigued by both string theory and loop quantum gravity when I learned of them as a philosophy student in the mid-1990s, neither seemed to me either intuitively or logically plausible models as they both rest on some dubious concepts about the nature of space, time, and energy. I was also becoming increasingly skeptical that the Universe as a whole is expanding as portrayed in the concordance cosmology—or, as it was more commonly known at the time, the Big Bang theory. That skepticism was due to the existence of alternative explanations for astronomical data [11], the Big Bang theory's recurring cosmic age paradoxes [12], and the theory's need to be patched up with a number of seemingly ad hoc auxiliary hypotheses, some of which carry implications in contradiction to observation in need of support with yet further ad hoc auxiliary speculations for their justification—epicycles upon epicycles [13]. I decided to look for a more plausible cosmology that would avoid the logical and empirical problems of the Big Bang theory while also offering a compelling account of space, time, and motion. Ultimately, I concluded that quantum gravity approaches should be revised with a new cosmological model of the structure of physical space and time. And so I created CSM—the Cosmic Sphere Model—as a possible alternative for a new cosmology.

In agreement with Albert Einstein (1879–1955) [14], CSM portrays the Universe as a finite hypersphere of four spatial dimensions, the three-dimensional (3D) surface of which we inhabit. Some cosmologists object to the hypersphere model of the Universe's geometry on the basis that astronomers find the Universe to be "flat" or Euclidean and not curved as required by a hypersphere. However, that objection forgets that astronomers are only measuring the *observable* portion of the Universe, which only extends to the cosmic microwave background (CMB) horizon, beyond which is presumably more physical space filled with more stars and galaxies we will never be able to glimpse. So, it is very possible that the observable portion of the Universe appears Euclidean only due to its relatively small size in comparison with the overall manifold geometry of the Universe as a whole.

In CSM, the 3D surface of the Universe's hyperspherical geometry appears within telescopic range to be a 'flat' (Euclidean) expanse while on the smallest subatomic scale, physical space is comprised of a foam-like geometry. According to CSM, space on the smallest of scales is composed of individual spheres called *vacuum bubbles* since they comprise the vacuum of physical space. Each vacuum bubble has a Planck-length diameter (10^{-33} cm)—so small as to be undetectable but carrying empirical effects at larger scales. The vacuum bubbles are connected with one another and do not become disconnected. They are arranged together contiguously as a *cosmic foam* on the quantum scale [15]. In other words, what we perceive as a smooth, continuous vacuum of empty space on macroscopic scales actually has a structure at the quantum level—a foam-like geometry made of vacuum bubbles.

So far this is not so different from loop quantum gravity's picture of space, or even the kind of space that the strings of string theory are said to move through—all of these conjectures describe the apparent emptiness of physical space as actually composed of discrete, Planck-scale entities undetectable by direct, empirical means. However, in CSM the dynamics of the cosmic foam are far different from the dynamics of loop quantum gravity, as the vacuum bubbles behave much more like the intersecting and diverging energy strings of string theory.

Just as strings are portrayed to merge and divide in particle interactions, so too I conceived vacuum bubbles of physical space as undergoing reactions with one another, some uniting into single, similarly sized vacuum bubbles (*vacuum unification*) while others divide like cells, multiplying into many other Plank-scale vacuum bubbles (*vacuum division*) [16]. This foaming activity among vacuum bubbles I proposed to be responsible for two phenomena: particle motion on the one hand; gravity and expanding space on the other hand.

First, the motion of particles. Each fundamental particle of matter is formed out of physical space via vacuum unification and dissolves back into space via vacuum division. A rapid, linear succession of these reactions over distance is what we perceive as particles propagating through space. So although vacuum unification and vacuum division are not measured as energy, their succession over distance as the manifestation of particles propagating *across* space is what physicists measure as the energy of particles in motion [17].

Second, gravity and expanding space. Vacuum unification and vacuum division underly the phenomena of both gravity and expanding space, which are emergent effects at larger scales. The multiplying vacuum bubbles manifest at intergalactic scales as cosmological space expansion while the merging vacuum bubbles manifest as fields of contracting space around planets, stars, galaxies, etc.—the gravity of celestial bodies [18].

The 'foaming' action of uniting and dividing vacuum bubbles underlying these phenomena operates according to a new physical law I called the *law of space-time conservation* [19]. Just as the law of conservation of matter was supplanted by the law of conservation of energy, so too the law of conservation of energy could be supplanted by a law of conservation of space-time [20].

According to the space-time conservation law, energy can transform into the medium of physical space (vacuum bubble division and multiplication), and the medium of physical space can also transform into potential energy (the unification and reduction of vacuum bubbles, especially into material particles), with both reactions balancing out such that the total surface area of the Universe's hyperspherical geometry—the Cosmic Sphere—neither increases nor decreases with these vacuum bubble reactions, thus maintaining a constant spatial size for the Universe throughout time [21].

Moreover, any slowing of time in one part of the Universe, such as in a gravitational field, is balanced by an increase in temporal rate elsewhere (such as in the voids between galactic clusters), maintaining an overall constant average temporal rate for the Universe as a whole. Hence, physical space and time remain conserved quantities on the scale of the Universe as a whole despite local divisions and unifications of the vacuum bubbles, which are also responsible for manifesting particles and their motions at the quantum level in addition to all larger-scale physical motion [22].

That, at its most rudimentary, is the core of CSM—the Cosmic Sphere Model of the Universe.

By turning away from standard approaches to cosmology and quantum gravity, CSM was a nonstandard cosmology based on a dissident physics model of the Universe. My proposal of CSM was, as a nonstandard model, intended to be a more plausible cosmology than the mainstream concordance cosmology with its reliance on quantum gravity theories such as string theory and loop quantum gravity. However, just like with the energy strings of string theory and or the energy loops of loop quantum gravity, it was not at all clear that either the existence of cosmic foam and its vacuum bubbles or its law of space-time conservation could be empirically tested. Realizing this, I proposed CSM not as a work of science per se, but rather as a speculative work of philosophy. As a nonstandard cosmology, CSM was based on physics (both conventional and dissident), but it was intended to be a *philosophical* model, not a rigorous scientific proposal [23].

Philosophy and *The Cosmic Sphere*

Academic philosophy has two traditions—the *analytic tradition* and the *speculative tradition*. The analytic tradition of philosophy offers analyses of concepts and ideas with the intent of clarifying their meaning and ascertaining their degree of rationality. The speculative tradition of philosophy offers just that—speculations (empirically untestable interpretations or estimations) about virtually any subject. Most academic philosophy is a mix of these two traditions.

Historically speaking, philosophers have speculated on a variety of topics, especially those outside the range of scientific observation and control. Once speculations become detailed enough to become testable, then they cease being speculations and instead become hypotheses or theories—in other words, they cease to be philosophy (or, at least, purely philosophy) and instead become science. Many subjects that were initially subjects of philosophy have since become sciences. Speculations about matter have largely been taken over by physics, speculations about cosmic origins have mostly become consumed by scientific cosmology and astrophysics, speculations about the nature of substances are for the most part a topic of chemistry; speculations about evolution are now primarily the territory of biology, and so on.

The success of the sciences has, in some cases, narrowed the range of philosophical speculation. A simple example: the shape of the Earth is no longer a matter of philosophical speculation. But in other cases, the success of science has actually opened up new horizons for philosophical speculation—like speculations of what lies below the world of quanta, or what lies beyond the cosmic microwave background horizon at the limits of astronomical observation, or what, if anything, lies beyond the three-dimensional Cosmos. Hence, the success of the sciences has in no way endangered the speculative tradition of philosophy.

In fact, science is based on (often tacit) philosophical assumptions and scientists frequently engage in philosophical speculation. However, with rare exceptions, these days science operates independently of philosophy as an academic field. That was not always so. Before the 20th Century, the sciences were sub-fields of philosophy. There are even historical examples of philosophers proposing speculations that were later made into testable theories and subsequently verified as facts. Two examples come from the ancient Greek philosopher Democritus (5th Century BCE) and the German philosopher Immanuel Kant (1724–1804).

Democritus (and his mentor Leucippus) proposed the existence of atoms as the elements making up all physical bodies [24]—an idea that at the time was pure speculation but which later inspired physicists to develop the idea into an actual theory, and eventually atoms as chemical elements were discovered. Kant, citing astronomer Thomas Wright of Durham (1711–1786), speculated there may exist other “milky ways”—that is, other galaxies—beyond our Milky Way Galaxy [25]. That speculation inspired astronomers to hunt for evidence of other galaxies beyond ours until one such astronomer, Edwin Hubble (1889–1953), succeeded in confirming their existence.

Certainly, some will point out that Democritus and Kant did not get all the details right about atoms and galaxies, and they proposed other cosmological conjectures that were later debunked. But that’s not the point. Nor is the point that they didn’t propose tests to determine the accuracy of their speculations. That’s not what speculation is about (or it wouldn’t be speculation). The point is that those speculations by philosophers inspired the hypotheses and theories later proposed by scientists, and such theories even became confirmed as fact. Ergo, Democritus and Kant, even as philosophers, influenced the pursuit of scientific knowledge for the better.

Likewise, some of the speculations offered by today’s philosophers and other innovative thinkers outside the scientific community are intended to inspire the professionals within the scientific community to create new scientific hypotheses and theories based on those innovative speculations. Of course, most speculations offered by philosophers or other innovative thinkers outside the scientific community will fail at this objective as such speculations will prove to be scientifically useless. However, some philosophers hope to offer speculation on some scientific observation that opens up a promising new line of thought in the field of science. That was my hope with *The Cosmic Sphere*, which I consider a work in the speculative tradition of philosophy.

Although parts of the book covered various scientific theories (some mainstream and some dissident), *The Cosmic Sphere* was not intended as a work of science per se. Nor was the book a work of the *philosophy of science* (in the analytic tradition), though there was some philosophy of science in its pages. Rather, the book was primarily a work of *scientific philosophy*—speculation concerning scientific models, theories, and findings [26].

I like to refer to scientific philosophy as *sci-phi* for short—the abbreviation being a deliberate play on the abbreviation sci-fi for science fiction [27]. Like science fiction, sci-phi is not science. However, unlike science fiction, sci-phi as scientific philosophy is intended to accurately describe, or at least closely model, the real world.

The Cosmic Sphere was an instance of sci-phi as the philosophical counterpart of theoretical physics and cosmology. In *The Cosmic Sphere*, I offered CSM as a sci-phi model of the Universe that could, in principle, be used by scientific cosmologists and theoretical physicists as a conceptual framework for developing new physical and cosmological hypotheses. If CSM showed promise, scientists could reform cosmology based on the conceptual framework of CSM [28].

Reception of *The Cosmic Sphere*

When I wrote *The Cosmic Sphere*, I was confident that CSM would prove more plausible as a model of the Cosmos than the more standard Big Bang cosmology (the ΛCDM model), which continually needed patching up when faced with refuting evidence. Moreover, CSM offered a much more natural topology for physical space than either string theory or loop quantum gravity. So, I had hope for CSM's prospects.

Still, CSM is sci-phi and not even close to being a well-developed scientific theory. A sci-phi cosmological model is one thing, but what physicists want is a scientifically *testable* cosmological model—especially if the model offered to them for consideration is drastically nonstandard. Scientists are loath to throw out an existing model unless one more testable and promising for research is offered in its place. I had doubts CSM could be made testable, and I had no calculations to make it precise enough for measurement. On the other hand, I believed that, in principle, CSM *could* be made testable, at least so as to be supported indirectly with scientific experiments or observations. Even so, because CSM as presented in *The Cosmic Sphere* was purely a speculative model, not a true hypothesis, I knew there was a good chance it may not garner any attention from the professionals in the community of theoretical physicists and cosmologists.

Even so, I rashly decided to push forward and publish *The Cosmic Sphere* for a wider audience that included lay seekers as well as what few professionals might be interested in an alternative approach. Among the professionals of the scientific community, the book was received about how I suspected it might be. *The Cosmic Sphere*, more sci-phi than science, sparked no interest among working cosmologists and theoretical physicists.

Proposing a nonstandard cosmology as an outsider to the physics community has its pitfalls, especially when that nonstandard cosmology is a work of sci-phi. One pitfall to proposing any cosmology contradicting the concordance cosmology supported by the majority of physicists, let alone a sci-phi cosmology, is that nearly all such attempts fail at their goal of being taken seriously enough to gain consideration by the professionals in the scientific community—which in the book's introduction I admitted would likely be the case [29]. And it was.

But as it turns out, that was a good thing.

Second Thoughts

I began to have doubts about CSM not long after publication. The model, which I was initially so confident in prior to publication, was just not cohering even with its own principles of motion when I subjected it to further scrutiny. So I went to work on reevaluating the content in the book. The more I reread the book and examined other theories, the more errors I found that would need correcting. After further contemplation, I concluded that *The Cosmic Sphere* was the work of a budding philosopher not yet mature as a speculative thinker concerning physics.

Still, I thought possibly CSM could be salvaged. So over the ensuing decade, I tinkered with the model. But ultimately, CSM no longer appeared plausible to me. The CSM model would have to be scrapped.

The following is a list of novel, but alas erroneous, concepts in *The Cosmic Sphere*:

- the subsumption of ontology and phenomenology into cosmology
- 'cosmic sphere' as the geometry of the Universe
- cosmic foam
- vacuum bubbles
- vacuum unification/division
- vacuum currents
- space-time conservation
- particle eversion
- eversion periodicity
- non-nuclear atomic model
- diamagnetic photon radiation
- redshift periodicity
- quantum 'ghost' waves
- quantum hyperlocality
- absolute coordinate space
- comparativity as a relativity alternative

That is not an exhaustive list, but those are the main concepts of the book that I now consider to be erroneous. Consequently, CSM is a cosmological model I can no longer promote—it represents a wrong turn in sci-phi speculation.

In addition to that list, there are content errors in *The Cosmic Sphere*—a few editorial, some factual, and several logical. I estimate that only about 20% of the book can be correct, which means it would require cover-to-cover corrections [30]. Rather than engage in a full rewrite, I advise any potential readers to just ignore *The Cosmic Sphere* in favor of better publications on the subject of cosmology—to include my vastly better-informed, forthcoming work on the subject. Needless to say, I've done my homework.

2. CSM and Fringe Science

There are those who are insiders to the scientific community and those who are outsiders to the scientific community. Perhaps most nonstandard cosmologies, and certainly most works of dissident physics, come from outsiders (incidentally, a great deal of dissident physics seems to come from retired engineers). But nonstandard cosmologies based on dissident physics are also sometimes proposed by insiders—graduate students, post-docs, professors, professional science researchers, etc.—specializing in scientific cosmology, astronomy, astrophysics, theoretical physics, and related disciplines.

When insiders to the scientific community propose nonstandard cosmologies or dissident physics, the works are part of *fringe science*, which stands in distinction from *mainstream science*, the latter of which is based on the near-consensus methods and approaches of the professionals in the given field of science [31]. The term ‘fringe science’ is frequently used as a synonym for *pseudoscience*, but in my opinion, they should be distinguished from one another.

Figure 1 is a simplification of the various categories of what is commonly called ‘science’ since in reality each category blends into the others, with no hard lines between them. For example, a single scientific research program may contain elements of mainstream science, fringe science, and pseudoscience.

Then too, notice in **Figure 1** that *junk science* is shown to be a combination of fringe science (a category of genuine science) and *pathological science* (a category of pseudoscience)—junk science is debunked fringe science that continues pathologically via die-hard adherents [32].

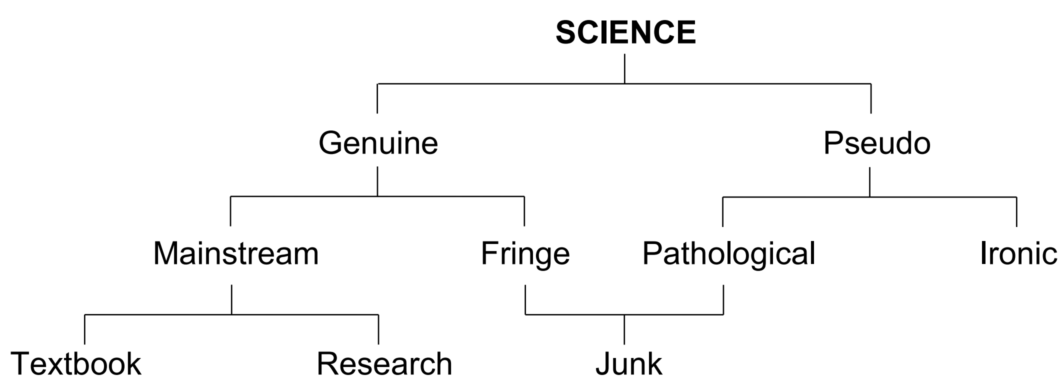

Figure 1: Types of science.

Fringe Science Defined

Pseudoscience is that which appears to be science but isn’t (see § 3). Fringe science, on the contrary, is genuine science but not mainstream—that’s why it’s on the “fringe” of the scientific community. With a few notable exceptions, pseudoscience does not usually appear in reputable science journals. Fringe science often does.

Definition:

- **fringe science:** *scientific inquiry, conjectures, findings, or applications offered for acceptance by an established field of science but departing significantly from the field’s dominant paradigm and/or consensus on facts, and thus considered questionable by the field’s mainstream proponents*.

Whereas pseudoscience is, with a few notable exceptions, dismissed or rejected by the mainstream, fringe science is neither accepted nor ruled out by the scientific consensus—instead, most scientists consider instances of fringe science "questionable." What the mainstream finds questionable about any instance of fringe science is whether it is (a) worthy of further research, (b) quality science, (c) even science at all, or (d) some of the above.

Fringe Science Examples

Though fringe science does not enjoy mainstream support, that does not in itself make it unrespectable. Both the *relativistic modified Newtonian dynamics* (RelMOND or RMOND) proposed by Constantinos Skordis and Tom Złośnik [33] and the *conformal cyclic cosmology* (CCC) proposed by theoretical physicist Roger Penrose [34] are examples of respectable fringe science. RelMOND and CCC are recognized by the mainstream as generally scientific in status, but neither is considered mainstream thought in astrophysics and the scientific study of cosmology since most researchers do not find either to be an approach worthy of further research.

A 2022 search on the scientific publication pre-print arXiv server for articles over the past ten years turned up 20,055 papers on dark matter but only 997 on any version of modified Newtonian dynamics. Those search results are consistent with the conclusion that dark matter theory is mainstream while RelMOND is fringe. The same search for papers on the concordance cosmology (ΛCDM cosmology or Big Bang) turned up more than 3,000 papers, but less than 30 on CCC. That is also consistent with the view that ΛCDM cosmology is mainstream; CCC is fringe.

Having fringe status does not mean RelMOND theories and CCC are wrong. It just means they are so unpopular among professional scientists that very few consider these theories worth developing further as compared with the more mainstream approaches. However, the status of these theories could change. Sometimes a theory starts out as fringe science (or even pseudoscience) but later becomes mainstream science. Both germ theory and the theory of continental drift are two examples [35]. Another example is the theory of the endosymbiotic origin of mitochondria [36].

It should also be noted that sometimes it's the other way around—a mainstream theory can later become a fringe theory. In the early 1900s, the Milky Way Galaxy was thought to be the whole Universe, while other "spiral nebulae" observed by astronomers were thought to be just small parts of the Milky Way [37]. By 1920, the Milky Way Universe cosmology lost its mainstream status. It was kicked to the fringe with new astronomical data showing that the spiral nebulae were likely other galaxies far from the Milky Way, implying the Milky Way is likely just one galaxy of many—not the whole Universe after all [38].

Furthermore, theories that were once mainstream but that have since gone fringe do not always stay fringe—they usually become completely refuted at some later point in time. The newly fringe status of the Milky Way Universe lasted only four years. In 1924 further astronomical observations proved conclusively the Milky Way is just one of many galaxies in a much vaster Universe [39]. Consequently, the theory of the Milky Way Universe was no longer fringe; it was just plain debunked.

Incidentally, just because two theories are in competition to explain something does not mean one is mainstream and the other is fringe. Two or more competing theories that contradict one another can be considered mainstream, rather like two rival political parties dividing the majority of a nation's population with other parties much more marginal. However, science tends to progress at a much faster rate than politics, typically resulting in one dominant theory as the other contenders lose favor and become increasingly fringe with most on the fringe of science eventually becoming debunked.

A good example from the early 1990s is the *textures theory*, a Big Bang model challenging the more popular *inflation theory* of the Big Bang. Textures theory was an up-and-coming contender that gained traction, but it was ultimately falsified by the 1992 Cosmic Background Explorer (COBE) satellite measurements [40]. In light of that falsification, proponents of cosmological textures revised their theory several times, but it was never again mainstream. Instead, the theory of textures was relegated to the fringe, where various revisions of it were proposed and refuted over the following 20 years [41]. (Inflation theory remains the dominant Big Bang paradigm but it is coming under increasing skepticism, including from some of its original adherents [42].)

There are also those fringe theories and practices that start on the fringe and continue on the fringe, neither gaining relevance nor being debunked. Two good examples are astrobiology and the Search for Extraterrestrial Intelligence (SETI) in astronomy [43]. RelMOND and CCC could share a similar destiny.

Finally, there are theories that start on the fringe, become increasingly pathological (see the next section), and end up being debunked as junk science. A good example of that is cold fusion [44].

Predominantly, for a theory to have the status of 'fringe' just means the majority of experts don't think it looks promising enough to pursue instead of much more trendy approaches that are in keeping with the consensus paradigm. Other theories, though, are fringe for a more serious reason: they have evidence steadily accumulating against them and prospects for them turning out to be true are looking bleak. As of this writing, a good contemporary example is the theory of single-wave quantum analogs [45].

CSM Versus Fringe Science

Was CSM, being a nonstandard cosmology based on some dissident physics, an instance of fringe science? No—at least, not according to the definition of fringe science provided above. There are two main reasons for this conclusion. First, because CSM was the proposal of an *outsider* to the physics community rather than a proposal by a maverick *insider*—fringe science is insider work. Second, because CSM as a whole is an instance of sci-phi rather than science. CSM is a speculative model, an interpretation rather than a hypothesis or theory that can be tested. As such, CSM as a whole is not science per se at all—not even fringe science.

That said, I must caveat that CSM does contain some fringe elements. In *The Cosmic Sphere*, I proposed that certain fringe theories by some dissident physicists in the scientific community should be considered as part of CSM [46]. Alas, most of those fringe theories have since been refuted by further scientific observation [47].

Though CSM as presented in *The Cosmic Sphere* did contain those fringe science elements that were later debunked, they were not critical to the CSM model itself. The critical portion of CSM is the cosmic foam operating by the law of space-time conservation. So even if the fringe elements are debunked, that would not falsify CSM per se. Both the cosmic foam and the law of space-time conservation could still be true. (However, I no longer believe either of them to be true and, regardless, they cannot be empirically proven or demonstrated to be true or false at all insofar as they are sci-phi speculations [48].)

3. CSM as Pseudoscience and Ironic Science

CSM was initially intended to be a sci-phi model of the Cosmos. As such it was to be purely speculative, though offered as a model with the *potential* to be further developed by professional physicists into a hypothesis that could be tested. Although there is nothing wrong with that, I did get ahead of myself toward the end of *The Cosmic Sphere*, proclaiming that CSM may indeed be, even as a work of sci-phi, a hypothesis that can be tested [49]. That was wrongheaded. I have since come to the conclusion that my former claim about CSM's testability is incorrect, both scientifically and philosophically. CSM, sans the aforementioned fringe elements, is very likely untestable by empirical means. It is just sci-phi speculation.

However, a wrong claim to scientific testability is more serious than just a mistaken claim. Any false claim that a conjecture is scientifically testable makes the conjecture not just an instance of sci-phi but rather a case of pseudoscience. Hence, in blurring the distinction between sci-phi speculation and scientific hypothesis, I believe that I inadvertently made CSM into an instance of pseudoscience, despite the arguments I offered in the book to the contrary in anticipation of that very charge [50].

Moreover, when a false claim of scientific testability is made of a sci-phi work, which is by definition purely speculative, then the sci-phi work becomes an instance of a particular kind of pseudoscience that journalist John Horgan named *ironic science* [51]. CSM, being a sci-phi model promoted with an erroneous claim to scientific testability, is an instance of ironic science.

Let's first examine what these terms—pseudoscience and ironic science—imply before further proceeding to assess CSM.

On Pseudoscience

Nonstandard cosmologies based on dissident physics—especially all in one book and without prior publication of supporting articles in mainstream academic journals—almost always turn out to be works of either fringe science (typically from science insiders) or pseudoscience (typically, when proposed by science outsiders) [52].

Not everyone agrees on how pseudoscience is defined, but here is a simple definition:

- **pseudoscience:** *any false claim to scientific status*.

A given *x* has 'scientific status' if *x* is a science or an instance of science. When we say of *x* that it is *a science*, we mean that *x* is *a reliable system for obtaining precise knowledge that improves understanding of the empirical world*. We can likewise say of some *x* (e.g., a technique, theory, fact, etc.) that *x* is an *instance of science* (or that *x* is *scientific*) if the following is true: *x* provides (or will provide) precise knowledge that improves understanding of the empirical world because *x* is obtained via (or is itself) a reliable, systematic method for such a purpose. If to the contrary, *x* is neither a science nor an instance of science by that understanding, but is nevertheless claimed or implied to be "a science" or "scientific" in that sense, then *x* is pseudoscience.

To clarify, not all knowledge of the empirical world is either *precise* knowledge or knowledge obtained by implementing some invented *system* for such, reliable or otherwise. So, not all knowledge of the empirical world is scientific.

On the other hand, just because not all knowledge is scientific does not make knowledge obtained by unscientific means pseudoscience. The only way that knowing something about the empirical world is itself an instance of pseudoscience is if that knowledge is *falsely claimed* to be an instance of science or scientific knowledge when it was really knowledge obtained via some nonscientific means. For example, knowing by memory alone is not a scientific way of knowing. If I know from memory what I wished for on my 6th birthday but claimed that knowledge is scientific, I would actually be practicing pseudoscience in making such a claim because knowing by private memory has no scientific status.

Essentially, if some x is claimed to be "a science" or "scientific," but isn't, then x is pseudoscience. Pseudoscience is a science imposter. Pseudoscience is the science equivalent of fool's gold—pseudoscience may look like science to the untrained eye, but it isn't really science.

There are many popular examples of pseudoscience, each of which falls into one or more of the following categories [53]:

- **occult science:** *systematic studies promoting belief in the supernatural and paranormal* (examples—parapsychology, cryptozoology, ufology, etc.).
- **vestigial science:** *any systematic study abandoned by the scientific community* (examples—astrology, alchemy, phrenology, etc.).
- **propaganda science:** *any fraudulent science used for promoting a political tribe* (examples—Aryan Physics, Eugenics, Lysenkoism, etc.).
- **alternative science:** *erroneous notions falsely promoted as overturning established science* (examples—Scientology, Creationism, Velikovskyism, etc.).

Those overlapping categories cover the most commonly recognized pseudosciences, but they are not exhaustive. For instance, another category of pseudoscience is 'ironic science'. Ironic science is categorically different from the above types of pseudoscience. I therefore prefer to distinguish ironic science from the foregoing types of pseudoscience which are more accurately termed 'pathological sciences' [54] (see **Figure 1** on page 8). What makes the two different is that pathological science is testable pseudoscience whereas ironic science is untestable pseudoscience.

Ironic Science as Pseudoscience

I conceive of 'ironic science' a bit differently than does the term's inventor. According to Horgan, ironic science is a post-empirical mode of science "akin to philosophy" in that it "offers points of view, opinions, which are, at best, interesting [but which] should not be considered literally true" because those points of view or opinions "cannot be empirically verified or falsified" [55]. Although I would quibble that truth can be a property of a statement even if the statement has not been proven to be true (and ergo philosophical positions can be true even if their truth is not provable), Horgan's point is nevertheless well-taken and I otherwise agree with his view of ironic science as so stated. However, I do diverge from Horgan's view on another point about ironic science: Horgan goes on to offer examples of ironic science that include certain philosophical positions I would say make no claim to scientific status and therefore should not be considered ironic science.

For instance, Horgan classifies philosophy and, in particular, panpsychism—a particular philosophy of mind—as an example of ironic science [56], which in my opinion is not accurate. Since at least the early 20th Century, philosophy has been distinguished from science such that philosophers typically lay no claim to being 'scientific' in the sense of practicing science [57]. Even scientific philosophy (sci-phi) is not the practice of science any more than science fiction (sci-fi) is the practice of science. Horgan's original notion of ironic science is thus too broad, in my opinion—it includes too much in its scope.

Then too, while I would call ironic science a brand of pseudoscience, Horgan does not seem committed to categorizing it that way. He sometimes refers to specific instances of ironic science as pseudoscience while at other times he doesn't go that far, saying instead that ironic science "verges" on pseudoscience [58]. Sometimes, he even promotes ironic science as a beneficial activity: "I do not mean to imply that ironic science has no value. Far from it. At its best, ironic science, like great literature or philosophy or, yes, literary criticism, induces wonder" even though ironic science "cannot give us the truth" because it is neither verifiable nor falsifiable [59]. I would say sci-phi is valuable but ironic science is not precisely because the latter is pseudoscience while the former is not.

On the Varieties of Conjecture

In support of ironic science as intrinsically pseudoscientific in nature, consider the manner in which science, sci-phi, and ironic science differ from one another with respect to *conjecture*.

Definition:

- **conjecture:** *an account (description, explanation, prediction, or narrative) without sufficient evidence to be fact*.

By this definition, three kinds of conjecture are *speculations*, *hypotheses*, and *theories*. These kinds of conjecture differ from one another with regard to tests for their accuracy in depicting some portion of the empirical world. Speculations are not, in actual practice, empirically testable conjectures—you can believe or disbelieve a speculation but, because a speculation is untestable, you can't know it to be true or false because it is just an opinion. In contrast, hypotheses and theories *are* empirically testable conjectures. However, hypothesis and theory are not synonymous. A hypothesis is a testable conjecture or a conjecture that has been tested; a theory is a hypothesis that has not only been tested but has survived refutation. Hypotheses and theories at least stand a chance of eventually being confirmed as fact and thus providing knowledge; there is no such assurance for speculations.

At least, that's the classical way of defining these kinds of conjecture with regard to science. Nowadays, unfortunately, scientists have allowed their use of these terms to become so loose that the terms have become rather slippery in their meaning. Terms such as 'hypothesis' and 'theory' have various, often incompatible, uses among the various fields of science. Sometimes these terms are even used interchangeably with other terms. For example, theoretical physicist Gerald 't Hooft remarked, "Regrettably, the words 'model' and 'theory' are very often mixed up in modern publications. Authors often prefer to call what they are working on a 'theory', even if they have not made the slightest attempt to figure out what it refers to in the real world" [60]. I agree with 't Hooft that such mixed-up terminology is a problem.

However, 't Hooft also opined that while a model is an idealistic abstraction that may or may not have any reference to the empirical world, in contrast "we should really reserve the word 'theory' for all those cases when a model is asserted to be a (possibly idealized) description of the real world" [61]. I cannot agree with that, simply as stated, because that way of defining theory does not place enough emphasis on testability.

The word 'theory' should be used as previously noted—a hypothesis that is tested and survives refutation is a theory, while a conjecture that is empirically testable is a hypothesis. A conjecture that remains untestable is just a speculation. A 'model' can be speculative, hypothetical, or theoretical—it all depends on how testable the model is and how empirically grounded it proves to be. Likewise for physical 'laws' such as the second law of thermodynamics, the constructal law [62], and CSM's space-time conservation law [63]—the latter of which is purely speculative. Of course, I don't get to control the language used in science. But if I had my way, scientists would be using the terms 'conjecture', 'speculation', 'hypothesis', and 'theory' as I have defined them. And the way I have defined them is how I will be using them.

According to the definitions I provided for the three kinds of conjecture (speculation, hypothesis, and theory), no one *knows* a hypothesis or theory, simply as such, is true or false. We can be justified in believing them true, but their truth is not *known*. Only once a conjecture, as a hypothesis or theory, becomes a thesis able to pass some critical test or series of unambiguous tests such that it proves reliable to trust as "the best obtainable version of the truth" [64] does the conjecture then cease to be regarded as a hypothesis or theory—a conjecture to merely believe or disbelieve. Instead, having passed a critical threshold, what was conjectured becomes considered safe to regard as no longer a conjecture at all. Instead, it can be rationally claimed to be knowledge—information known to be true and not merely believed to be true. Since knowledge claims are fallible, a claim to knowledge needs to be independently verified by another party. When verification occurs by a second party, we say that the knowledge claim is *confirmed*. Upon confirmation, the knowledge that was claimed to be such also becomes "established" as a *fact*, such as a *scientific fact*. This epistemic transformation sequence is depicted in **Figure 2**.

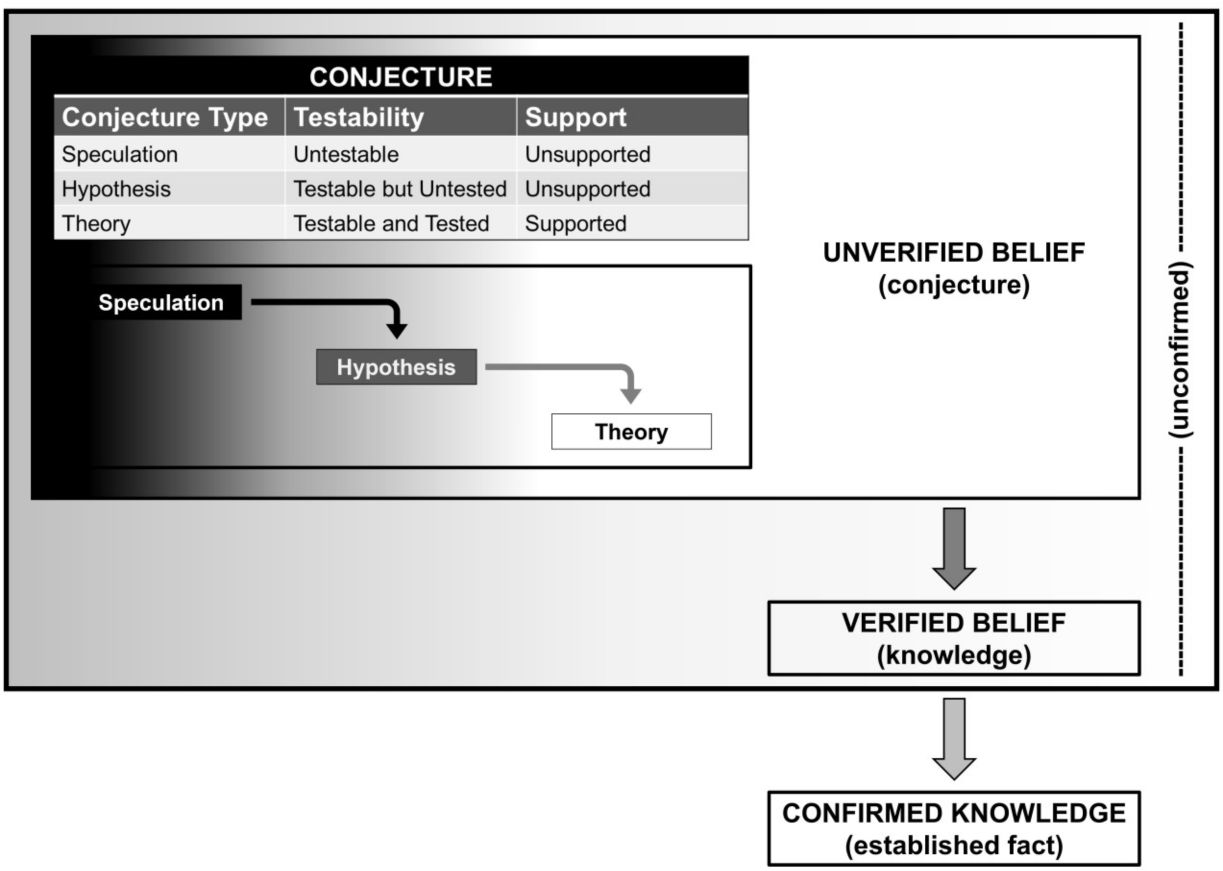

Figure 2: The epistemic sequence. (Arrows indicate transformation.)

Conjectures typically start as speculations while some graduate to become hypotheses; the fortunate hypotheses become theories. If a theory is successful enough, it may move from the lesser epistemic status as an unverified and unconfirmed belief that x (conjecture) to the greater epistemic status of being a verified but unconfirmed belief that x (knowledge, simpliciter), and perhaps even to the greatest epistemic status of all—confirmed that x is the case (i.e., x is known to be a fact) [65]. In actual scientific practice, not all conjectures follow the idealized epistemic transformation sequence illustrated in **Figure 2**. However, this transformation sequence for conjectures does reflect the increasing strength of conjectures as they are developed from speculative, to hypothetical, to theoretical, to convergence with knowledge. The sequence also reflects the goal of science as the pursuit of (factual) knowledge.

As a good example of the transformation from mere belief to knowledge, from conjecture to established fact, just take how the Earth's astronomical system was discovered to be Sun-centered. The statement "The Sun is the center of our astronomical system" was at first a speculation, then it became a hypothesis, then a theory, and now hardly anyone outside of historians refers to the 'heliocentric model' of our astronomical system, or 'heliocentrism'. Our astronomical system is now called *the Solar System*, and it is no longer referred to as if it is just a theoretical model to be believed or disbelieved. Instead, we commonly refer to "the Solar System" without qualification—the statement, "The Sun is the center of our astronomical system" is now a 'scientific fact'. As a fact, that statement is confirmable (and it happens to be confirmed)—it's not just a matter of belief.

Of course, not all speculations become hypotheses or theories, let alone established as truths or facts. Most don't. Speculation holds, at best, the *promise* of being testable after obtaining some, as yet undiscovered or unobtained, means of performing the needed observation or acquiring the needed data. A hypothesis, on the other hand, is testable in scientific practice by known and available means. You can perform a test to support or dispute a scientific hypothesis; you can't do the same for a mere speculation, even one based on scientific data. Speculations, sometimes under further revision, can become hypotheses, but there's no guarantee.

Speculations, like hypotheses and theories, can be *based on* facts, or *grounded in* facts, but they are still speculations and therefore unknown to be true. In 2017, an object that astronomers named *Oumuamua* passed through our Solar System on its way back out into interstellar space. The sighting is a confirmed fact from empirical data. But it is unknown what Oumuamua is. All we can do is speculate. Perhaps it was a chunk of nitrogen ice or maybe an exotic asteroid, or even a stray piece of extraterrestrial technology. All of which are speculations based on the scientifically gathered facts of the sighting, but some of those speculations (ice and asteroids) are more plausible than others (alien technology) [66].

Now we can return to the distinction between science, sci-phi, and ironic science with regard to these kinds of conjecture.

Science, Sci-phi, and Ironic Science

Science is and should be empirically testable with respect to its conjectures—scientific conjectures are hypotheses and theories. Sci-phi is speculation and only speculation, however based on scientific observation and data it may be. And given the forementioned distinctions among the various kinds of conjecture, Horgan's definition of ironic science should be revised as follows:

- **ironic science:** *science-based speculation falsely portrayed as scientific hypothesis or theory*.

In other words, ironic science is sci-phi falsely portrayed as science—a form of pseudoscience.

Science pursues *knowledge* about the empirical world rather than only *beliefs* about it, and that pursuit of knowledge requires conjectures to be empirically testable—a scientific conjecture must be a *hypothesis* or *theory* and not just a *speculation*. Whereas speculation can only provide belief and such belief is not necessarily scientific.

Speculation based on scientific findings is part of philosophy in its speculative tradition—it's just scientific philosophy (sci-phi). Sci-phi can even be rendered in the precise language of mathematics. That kind of speculation is nothing more than a technical form of metaphysics, which is a subfield of philosophy, not science. Sci-phi is not about empirical knowledge, but about beliefs regarding the empirical world; the same is true of ironic science.

When an instance of sci-phi, even in a rigorously mathematical expression, is said or implied to be 'science' while being empirically untestable, then it becomes 'ironic science' since that instance of sci-phi then qualifies as "post-empirical"—neither verifiable nor falsifiable—just as Horgan stated. Ironic science is thus sci-phi speculation claimed to be scientific hypothesis or scientific theory, and so ironic science is sci-phi speculation that is falsely claimed to have scientific status. So, when speculation however based on real science is falsely portrayed as hypothesis or theory, then it is ironic science, and as a *false* claim to having scientific status, any instance of ironic science is a form of pseudoscience.

Ironic Science as Mainstreamed Pseudoscience

Scientific conjectures are empirically testable conjectures. A conjecture that cannot be tested empirically is not a scientific conjecture. I do not mean that tests must be powerful enough to *verify* or *falsify* the conjecture in question. Rather, I mean only that scientific conjectures must be empirically testable so as to at least 'support' or 'count against' a conjecture in a manner that is *unambiguous*, even if the tests in question cannot result in a decisive verification or falsification.

In contrast, any conjecture that is "post-empirical" is, by definition, not a scientific conjecture. Hence, much of the irony of ironic science is the false claim to scientific status while proceeding in a post-empirical mode of inquiry—ironic science is ironic because it is intended to be genuine science but can't be [67]. But what is perhaps most ironic about ironic science is that it is practiced even by *insiders* to the scientific community such as reputable, mainstream scientists. In other words, mainstream science includes, ironically, the practice of pseudoscience—at least, of the 'ironic science' variety [68].

According to Horgan, a good example of ironic science is string theory [69]. As the word 'theory' is classically used, the name 'string theory' is at best a misnomer and at worst misleading. In order to qualify as a scientific theory, a conjecture has to be empirically testable—able to be unambiguously supported or refuted by observation or the accumulation of physical data. String theory is a mathematical model of physical particles for which there is no unambiguous empirical test to show whether or not particles really are vibrating strings of energy. String theory isn't a theory in the scientific sense; at best, it's just a 'theory' in the mathematical sense, and so string theory is inaccurately portrayed to be a scientific theory. As 't Hooft noted, "Actually, I would not even be prepared to call string theory a 'theory,' rather a 'model,' or not even that: just a hunch" [70]. As such, string theory fits the bill for constituting an instance of ironic science, just as Horgan identified [71].

Moreover, as an ironic science, string theory is a form of pseudoscience since it is untestable but purported to be scientific. And since string theory is practiced by the scientific mainstream, it turns out that string theory is mainstreamed pseudoscience. String theory thus enjoys a kind of respectability that most pseudosciences do not: it even regularly appears in many reputable science publications [72]. The example of string theory thus shows that pseudoscience infects science itself thanks to actual scientists promoting such "post-empirical" theory. Pseudoscience from scientists—indeed part of the irony of ironic science.

String theory is not the only mainstream pseudoscience, though. There are other forms of ironic science practiced by actual scientists as well, many of them only "testable" by thought experiments (which is also true of purely philosophical speculations) [73]. Speculations testable only by thought experiments are not really science but only sci-phi. If wrongly purported to be scientific, they are pseudosciences. Horgan includes as examples multiverse theory, the anthropic principle, and yet other cosmological speculations [74]. These instances of ironic science are currently practiced by mainstream scientific community insiders, appearing even in mainstream science periodicals.

It's always possible that a pseudoscience, including an ironic science, can be revised into a genuine science, but I suspect that eventually string theory, loop quantum gravity, multiverse theory, wormholes, and other instances of ironic science will be commonly recognized by science insiders as pseudosciences. For the time being, though, they are kept around only because physicists don't have better, empirically testable ideas [75]. However, if their proponents wish them to lose their ironic science status (and ergo status as pseudosciences), then the proponents either need to make some risky predictions that can be empirically tested, thus turning those so-called "theories" into genuine hypotheses, or the proponents need to acknowledge that these "theories" are really just speculative models, perhaps useful as background assumptions or interpretations but no more than just modern day metaphysics—mathematical versions of sci-phi.

Horgan revealed how a great deal of ironic science is generated *within* the scientific community [76]. But I recommend broadening the concept of ironic science to cover any instance in which untestable speculation—even if based on genuine scientific facts or data—is falsely claimed to have the status of a scientific hypothesis or theory. That implies ironic science need not be a form of pseudoscience practiced solely by insiders to the scientific community but also may be practiced by any unaffiliated, independent researcher whom the scientific community does not recognize to be an actual scientist—the kind of independent researcher I call an *outside innovator* since they operate outside the scientific community but seek to make a contribution to the advancement of science.

Ironic Science and the Outside Innovator

The outside innovator is not merely an independent researcher with a relevant doctoral degree, but someone able to publish in reputable science journals if they so choose (like Dr. Stephen Wolfram) [77]. Those are scientific insiders even if they are not affiliated with an academic institution. Nor is the outside innovator the unaffiliated or amateur scientist without relevant academic credentials but who nevertheless "speaks the language" of the inside professionals and has "reached the pitch of professional excellence" while proposing a nonstandard theory—the kind of individual science professor Isaac Asimov (1920–1992) referred to as an *endoheretic* [78]. The endoheretic, by definition, still counts as an insider to the scientific community [79]. Asimov gave the example of physician Robert Mayer and brewer James P. Joule proposing the law of conservation of energy, though both went unrecognized for it. They were endoheretic insiders to science, despite having no academic credentials [80]. Outside innovators, being outsiders to the scientific community, are not endoheretics.

On the other hand, the outside innovator is also not the one Asimov called an *exoheretic* [81]. While the endoheretic is the maverick researcher working inside the scientific community, well-acquainted with scientific practice and protocol, the 'exoheretic' is conversely the true outsider to the scientific community—one who is "so unaware of the intimate structure of science, of the methods and philosophy of science, of the very language of science, that his views are virtually unintelligible from the scientific standpoint" [82]. Asimov's exoheretic certainly captures many unsophisticated pseudoscientists well, but it does not necessarily capture all outsiders who opine on matters scientific with attempted innovations.

The outside innovator is, like the exoheretic, an outsider to the scientific field to which they wish to make a contribution in the sense that the professional scientists in that field would not consider them a peer. However, unlike the exoheretic as described by Asimov, the outside innovator is well enough educated in a given field of science, either from formal education or self-education, to hold an informed opinion about particular subjects studied in a given field of science. Despite having an above-average level of scientific understanding, the outside innovator remains "outside" the given scientific field to which they wish to make a contribution because they have either insufficient technical expertise for their contribution to meet the standards needed for acceptance in reputable science publications or insufficient academic credentials for recognition as a peer among professional scientists, or both.

Definition:

- **outside innovator:** *one who is not a member of a scientific community (hence, one 'outside' of science) but is nevertheless scientifically educated enough to propose an innovative idea intended to improve scientific understanding or research*.

Despite a lack of sufficient technical expertise and/or academic credentials, the outside innovator is well enough informed of the science and the requirements for science as a discipline to have developed an innovative idea—that is, an original idea by which they believe a currently accepted scientific theory or paradigm can be improved or superseded. Outside innovators often attempt to contribute their (allegedly) innovative ideas for the consideration of professionals working in the scientific field pertaining to their innovation. The most common attempts at outside innovation are unconventional alternatives to evolution by natural selection, dissident physics proposals, and non-standard cosmologies.

Unfortunately, many of the unconventional works of outside innovators are speculations incorrectly claimed to be testable and therefore scientific. Ergo, most proposals by outside innovators tend to be works of ironic science, despite the best intentions of their advocates. The irony of 'ironic science' still holds, even for outside innovators.

CSM—One Outside Innovator's Ironic Science

CSM was my own attempt as a philosopher of the speculative tradition, and a scientific community outsider, to offer an innovative contribution for the benefit of scientific cosmology and theoretical physics. And I think it's safe to say my attempted contribution was indeed something innovative: the conception of a new law of physics—the law of space-time conservation—as well as CSM itself as a notional model for the geometry and topology of physical space on both quantum and cosmological scales.

That said, CSM did not inspire scientific interest, precisely because it was a work of sci-phi and not science, offered by an outside innovator and not an endoheretic (a maverick insider to science). Moreover, CSM did not have the technical rigor physicists are looking for *qua* physicists. CSM was merely a notional model, not nearly precise enough to guide scientific research. CSM offered no clear mathematical content and no clearly workable experiments. I'm sure to trained eyes, it must have been more obvious than it was to me at the time of publication that CSM was an implausible model—a model that stands refuted just as a matter of conception.

Speculations can be refuted without being debunked by empirical tests. A speculation may be refuted by showing it to be implausible in a comparison with other, more likely, possibilities. A speculation can certainly be refuted if it can be shown to contradict itself, rest on contradictory assumptions, or imply contradictions.

I now see the core of CSM as refuted in that sense—it is not empirically refuted, as if it were proven inconsistent with empirical data or observation, but rather it is refuted on logical grounds as an implausible speculation. Empirical considerations aside, CSM is basically too *logically* flawed to be plausible as a model for the Universe's features of space, time, and motion.

Moreover, at the end of *The Cosmic Sphere*, I incorrectly claimed scientific testability of CSM when such is not the case. That unfortunate claim transformed CSM from sci-phi into ironic science, an instance of pseudoscience.

4. Assessing the Pseudoscience in *The Cosmic Sphere*

Endoheretics in science and philosophy propose unconventional views that either succeed or fail at overturning the reigning paradigm or scientific consensus on what constitutes established fact. Success stories in science include that of Einstein, who overturned the Newtonian proposal of absolute space and time in addition to the theory of the luminiferous aether [83]. One success story in academic philosophy is that of Ludwig Wittgenstein (1889–1951), who overturned the prevailing assumption that words have *essential* meanings over and above their conventional meanings—their uses in various contexts [84].

Even if the mavericks of science and philosophy fail in overturning conventional beliefs or assumptions, their failures tend to be plausible and within the bounds of their field's practice. Moreover, some of their failures may even be worth a second look. A good example is Einstein's proposal of the *cosmological constant*, which he later rejected as a blundered theory but which has since made a comeback in cosmology as the theoretical *dark energy* [85]. In the field of academic philosophy, Wittgenstein's posthumous book *Philosophical Investigations* overturned his earlier work entitled *Tractatus Logico-Philosophicus* [86], which is still studied by students of philosophy. The examples of Einstein and Wittgenstein illustrate that the mistakes of successful mavericks are the kind of mistakes geniuses would make.

In contrast, *The Cosmic Sphere* was not a brilliant mistake. It was the kind of mistake only a young and naïve outsider to the scientific community would make. Alas, I cannot claim to be one of those brilliant endoheretics.

On the other hand, at least unlike many exoheretics, I did not go so far as make the audacious claim that my model of the Cosmos constitutes a "discovery" or "breakthrough" promising to overturn the mainstream paradigm in a Copernican-style "revolution." It's true I proposed CSM as a new, speculative model of space-time that I did indeed believe had the potential, if further developed by professional physicists, to dissolve several longstanding problems in physics at once—an audacious undertaking [87]. That said, when I wrote *The Cosmic Sphere*, I didn't think of CSM as "revolutionizing" cosmology or physics. Nor was it my intent to portray myself as a revolutionary or as a physicist at all. *The Cosmic Sphere* was intended as a sci-phi work calling for a *reformation* within science rather than a revolution of science from an outsider such as myself [88]. CSM was proposed as an alternative model for professional scientists to assume as a conceptual framework in developing *their own* theories going forward. It wasn't about physicists starting over with philosophy, but rather about physicists adopting a better set of philosophical assumptions upon which to build better scientific theories to resolve some long-standing problems in cosmology [89].

Even so, the book was a crude attempt at a new paradigm. Mere months after the book was published, I came to realize that much of my CSM proposal was flawed owing to a much too superficial understanding of some physical theories about which I should have been much more careful. Mistakes I'll take care not to make again. Chalk it up to my being young and naïve at the time of publication.

5. Motivations Behind *The Cosmic Sphere*

There are various reasons as to why independent researchers propose nonstandard cosmologies or works of dissident physics. But I suspect that among such reasons there are some common ones shared by the independent researchers I refer to as 'outside innovators' (as opposed to exoheretics who promote the types of pseudoscience listed in § 3). I will provide an overview of such reasons, which were also behind my own proposal of CSM and publication of *The Cosmic Sphere*.

Where Science Ends, Philosophy Begins

One reason that outside innovators propose nonstandard cosmologies or works of dissident physics has to do with the tentative nature of science. Science has established many facts, such as the quantum spin of electrons or the redshift-distance relation of galaxies in the large-scale structures of the Cosmos. But much of science is still very much *theoretical*—from the Big Bang to quantum strings. Alternative facts do not exist, but alternative theories do. The difference between fact and theory, something known and something commonly believed, is sometimes downplayed by mainstream paradigm advocates [90]. But theories are not facts, nor are facts the same as theories. Theories may be *supported* by tests or observations, but support is not the same thing as verification, let alone confirmation as fact. Theories—even well-supported ones—still have a greater degree of fallibility, of tentativeness, than assumed facts. The facts are known; theories are yet a matter of belief. And so much of theoretical physics and cosmology, simply *as* conjecture-laden disciplines, are yet matters of belief rather than knowledge. True, belief in some of those physical theories is highly justified due to the support the theories receive, but much of physics is nevertheless theory so insufficiently supported by evidence that it stands little chance of becoming a fact. Indeed, much of what is called "theory" these days in physics and cosmology is, as yet, just speculation falsely purported to be science—it is ironic science [91]. That is what allows room for alternative conjectures—even by aspiring outside innovators.

Defenders of the scientific mainstream fire back that we live in an unprecedented age of *precision* in the sciences. Scientific cosmology, for instance, is now frequently referred to as 'precision cosmology' [92]. But much of what passes for precision in cosmology (as opposed to precision astronomy) is not precise *knowledge* of the physical world but rather is still conjecture in the form of precise mathematical *modeling* of the physical world, with the accuracy of those models unable to be empirically tested in an unambiguous way.

A good example of this sort of 'precision cosmology' is the so-called "theory" of inflation, which Horgan rightly identified as an instance of ironic science [93]. Horgan correctly points out that we should be skeptical of claims to high precision in support of cosmological conjectures such as inflation since so many of the scientific "observations" used to support such conjectures are *theory-laden* observations. In other words, what is "observed" is often just ambiguous empirical data that must be interpreted according to unproven assumptions and untestable speculations, however precisely they may be expressed in mathematical form [94].

Even some of the more empirically well-established theories are still underdetermined in certain facets. As an example, consider that the one-way speed of light (as opposed to the two-way speed of light) and the constancy of the speed of light over the age of the Universe cannot be tested to confirm Special Relativity as fact, vice theory [95]. Such examples show that even well-established theories may rest on some untested, and perhaps untestable, assumptions and so may still be questioned, despite the passionate defenses of the mainstream [96].

Then too, entire fields can end up supporting false theories due to flawed reasoning or flawed assumptions. After all, it's happened before. Over history, many once-popular scientific theories have ended up debunked [97]. Recall epicycles, caloric heat, phlogiston, spontaneous generation, gemmules, the luminiferous aether, and all the debunked cosmologies—the Geocentric Universe, the Heliocentric Universe, the Milky Way Universe, the Steady-state Universe, and so on. All of these theories were once widely accepted as constituting well-established, well-supported scientific theories. All of them were eventually overturned but passionately believed in by the scientists of their day. Indeed, so much so that any skeptic of them was ridiculed by the defenders of those former mainstream theories, especially if the skeptic cottoned to an alternative conjecture [98]. And the foregoing list of debunked mainstream theories is of just the famous theories that failed; there are plenty of lesser theories once in the consensus for a brief period of time but which are now forgotten by everyone but antiquarians. While facts do not get overturned, even the most popular of theories may be. The scientific consensus on today's theories may not last.

That's not to say outside innovators see everything in physics as up for grabs. There are plenty of facts in the concordance cosmology, relativity, and quantum mechanics received as uncontested by outside innovators. It's not the *facts* that are in dispute. Rather, it's the consensus *theories* that outside innovators hope to challenge with a nonstandard cosmology or work of dissident physics. And there are still even well-established theories that might become overturned, as some reputable scientists concede is possible [99]. That in turn gives fuel to the cause of outside innovators.

In defense of mainstream scientific theory, some retort that physics is not likely to change much anymore—the age of big paradigm changes, such as from Newtonian absolute space to Einstein's relativistic space, is over [100]. Science has already converged on the best obtainable version of the truth [101]. Progress in understanding the world is just a matter of incremental changes now, no more than filling in the details. So don't expect any further, big paradigm changes. Just as theoretical particle physics rests firmly on facts established by quantum mechanics [102], so too the concordance cosmology rests firmly on modern astronomy and astrophysics, so there will be no big Copernican Revolutions from here on out.

There is something to be said for this view, but science may not be ending yet. Rather, it may be stagnating until the next generalist arrives to pull disparate lines of observation and data together into a new interpretation of physical reality. One that opens up new lines of inquiry in science, new methods of testing we haven't thought of before, and from which springs a subsequent accumulation of new evidence in support of new theories evolved from those reinterpretations of scientific data. The outside innovators are hoping to provide a new paradigm in physics and cosmology with their alternative ways of interpreting what we currently know through established approaches. Whether they succeed is another matter, but that is their endeavor.

And it appears the ground is fertile for them, for there is still much in science that is unsettled. Particle physicists still don't know for sure what particles are. They must conjecture about the true nature of particles—speculating that they may be vibrating strings of energy [103], excitations in a quantum aether (or 'ether') [104], mere points in a mathematical space [105], etc. Then too, for all the chiding physicists give psychologists about not agreeing on what it is they study (Is it mind? Is it behavior? Is it mind *and* behavior?), that overlooks the lack of consensus on what quantum mechanics is all about. Back in the mid-1980s, there were at least eight different interpretations of quantum mechanics [106], but even then more were appearing and now there are at least a dozen popular interpretations from which to choose and all of them fit the same data [107]. The same goes for cosmology—new cosmological models are continually being proposed by theoretical physicists and cosmologists. Some agree on how to interpret data like redshifts and galactic rotations, but some do not. One new, albeit fringe, cosmology by a respected physicist even states that the Universe began cold rather than hot and that all matter is shrinking rather than space expanding between galaxies [108]. Physicists adhering to the concordance cosmology had to admit that the astronomical and astrophysical data do indeed allow for such an interpretation due to the *dimensionless ratios* used in astrophysical measurement [109]. Hence, many scientific *measurements* may stand as settled, but the *interpretations* of those measurements are not. It's in the world of interpretation that science ends and philosophy—or sci-phi—begins. It may not be that science is ending, but that the old science is ending and the new science has not yet arrived. And so it remains possible for sci-phi speculation to lead to new scientific hypotheses; likewise, new scientific paradigms may still emerge. It is in the world of scientific interpretation and speculation concerning scientific findings and data that outside innovators—philosophers, engineers, etc.—hope to make a contribution. While such contributions to science from outside innovators are unlikely to be successful, it is also not necessarily unheard of, as previously illustrated by philosophers such as Kant [110].

Outside innovators also see their alternative proposals as justified based on how *weird* some of the mainstream theories have become—something defenders of the mainstream often overlook. Mainstream *physics weirdness* includes *cosmological weirdness* (an expanding universe, parallel universes, singularities, spacetime wormholes, etc.), *relativity weirdness* (reciprocal length contraction and time dilation, acceleration/gravitation equivalence, block spacetime, etc.), and *quantum weirdness* (entanglement, acausality, retrocausality, alternate histories, consciousness-created realities, etc.). Proponents and defenders of mainstream physics have become so used to their own brand of weirdness that they no longer think of it as weird. But to many outsiders, it's precisely that mainstream physics weirdness that sounds farfetched or even crazy [111].

Basically, outside innovators find mainstream physics weirdness too *implausible* to be true. Part of the implausibility may stem from an intuition the outside innovator has that some of the physics weirdness is still theoretical or even just interpretive—either way, *underdetermined* by the evidence. Then too, some mainstream theories and models also seem rather *unrealistic*—like abstract, toy models of the world rather than accurate depictions of the real world. Such theories seem to be what philosophers of science call 'useful fictions' [112].

Further, the defense of mainstream physics weirdness sometimes comes off as a rationalization rather than a rationale, especially when the mainstream defends its own form of weirdness by appealing to scientific conventions. Physics professor Michael Friedlander explained that "in reality many of the theories that we have entertained are just as bizarre as those that we have rejected out of hand, but…they differ in some very important ways" [113]. Other scientists say much the same: "The distinguished physicist Niels Bohr once told another physicist: 'We are all agreed that your theory is crazy. The question which divides us is whether it is crazy enough to have a chance at being correct.' Science, then, does not eschew crazy theories. But one must go about one's craziness in the proper way" [114].

In other words, the physics weirdness accepted as mainstream science is the type of 'crazy' that follows good scientific practice. Hence, if defenders of physics weirdness do admit the more theoretical side of physics seems weird or crazy, they tend to take it not as a sign that physics is heading down the wrong path but rather that certain phenomena in the physical world operate according to counterintuitive principles that are contrary to common sense. In other words, mainstream scientists tend to regard physics weirdness as just the product of uncovering how weird physical reality actually is [115]. But outsiders to the physics community do not always share their confidence. While many scientific community insiders see such notions as consciousness-created reality and time-traveling quanta [116] as legitimate forms of crazy, to many outsiders these notions sound more like the kind of crazy that the scientific method is woefully inadequate for filtering out. Hence, many outsiders to the scientific community interpret mainstream theoretical physics and scientific cosmology as having abandoned the quest for *plausible* theories for how nature works in favor of developing and rationalizing increasingly and unnecessarily weird theories.

To the outside innovator, mainstream physicists in the Copenhagen tradition, for example, appear like a gullible audience to nature's quantum magic show, theorizing as to how magic works; instead, they should be more like a skeptical audience in the Einsteinian tradition looking for a theory as to why the quantum magic is only an illusion. The same could be said of certain aspects of relativity and cosmology as well. The outside innovators hope to remedy implausible physics weirdness with more plausible, albeit nonstandard, cosmological models or alternative approaches to physics.

Admittedly, the critiques of mainstream physics weirdness as offered by aspiring outside innovators are not always accurate. Critics of the mainstream physics weirdness often do not sufficiently appreciate that there are solid reasons when respectable scientists otherwise feel the need to resort to weird or "crazy" theories. If such weird theories are wrong, it is not always obvious why they should be wrong, even to the experts. Consequently, the critiques of physical theories by philosophers in particular have sometimes missed the mark to embarrassing degrees [117]. Some of my own critiques in *The Cosmic Sphere* are a case in point [118].

Moreover, critics of mainstream physics weirdness often base their critiques of such on secondary literature reports about the theories rather than on the primary literature itself. Unfortunately, the secondary literature often paints a misleading picture of what the theories actually say. Consequently, the critiques of mainstream theory are often straw figure fallacies. This too was a problem with some of the mainstream critiques in *The Cosmic Sphere* [119].

Because of erroneous critiques of physics weirdness offered by outside innovators and exoheretics, proponents and defenders of the mainstream regard the concordance cosmology and certain aspects of relativity and quantum mechanics, weird though they may be, as simply settled matters such that any further critique of them is regarded as a vestigial relic of debates gone by—the arguments of those who "just can't philosophically accept" the weird cosmos that science has revealed [120].

Still, skeptics of the mainstream physics weirdness and outside innovators offering alternatives to that weirdness do have a point. Consider, for example, how Galileo proposed the weird notion that the planet Saturn has a pair of handles [121]. Further observation revealed that those "handles" were a mere artifact of poor telescopic resolution [122]. Once it was shown that Saturn had rings, merely seen from various relative angles during the planet's orbit, the weird idea of a planet with handles was thrown out as a silly mistake. The same could go for certain weird aspects of the concordance cosmology, of spacetime relativity, or of quantum physics. Much of the physics weirdness accepted today as counterintuitive fact may prove illusory under further observation. If so, the skeptics of mainstream physics weirdness will have been proven right to not "philosophically accept" the picture being painted by many of the mainstream theories today.

The defenders of mainstream physics weirdness also have some unconvincing apologetics.

For example, some defenders of mainstream physics weirdness [123] go so far as to argue that if we were to reject one part of established physics, that would unravel all of physics since all the well-established theories are so interconnected [124]. And they support that position with another: that with just one part of physics, the rest can be deduced [125]. But this is simply rhetoric rationalizing the mainstream physics weirdness as if to accept one part of physical theory requires accepting all of those popular physical theories—the whole-package-or-nothing argument of the dogmatist, and such rhetoric is not at all accurate.

In fact, physics theories are flexible enough to be tweaked without unraveling all of physics. Just take some of the natural regularities assumed to be physical 'constants' of nature such as the fine-structure constant. There is some evidence that the fine-structure constant may not be so constant after all [126] [127]. The jury is still out but, even if true, all of physics will not unravel because such presumed constants turn out not to be so constant after all. If, for example, the fine-structure constant is revised as the fine-structure tendency, that's not going to invalidate the Pauli exclusion principle or Einstein's energy-mass relation ($E = mc^2$).

Moreover, there is no way to deduce certain aspects of the physical world from just one part of physics—one cannot deduce the cosmological redshift from Planck's constant, nor can one deduce from the energy-mass relation the shape of atomic orbitals.

Then too, some cherished theories are very successful in one area while epically failing in another. Quantum field theory is a good example. While its principles have given remarkable predictions of previously undiscovered particles and physical effects between them, quantum field theory also predicts the Universe should contain so much virtual matter that it shouldn't even exist. Some call that the worst prediction in all of physics [128]. But even though physicists know quantum field theory is flawed in certain respects, they do not see those flaws as fatal. Rather, quantum field theory is retained since it still produces correct results in most other areas of its domain of application, enough to enable other lines of research reliant on them to continue making progress until a better theory comes along.

So, contrary to mainstream theory defenders, not all physical theory is so interconnected that changing one well-established theory would change them all, nor can all of physics be deduced from only part of physics, nor must we accept the whole mainstream package just because certain parts of it prove correct. Claims to the contrary are instances of dubious epistemology and apologetics intended to bolster the accepted paradigm against potential rivals and promote the mainstream physics weirdness as if fact. The erroneousness of these apologetics only adds additional reasons as to why outside innovators pursue alternatives to the standard physics models of the natural world.

There is yet another reason outside innovators may have for some of their skepticism of mainstream scientific theory and for their subsequent pursuit of alternative paradigms. While not all scientific theories need to be true in order to be scientifically useful, it's also the case that some popular theories are useful even though they are based on false premises [129].

A good example in physics is any theory that, though offering the wrong explanation for a given physical phenomenon, can nevertheless produce correct predictions. Such a theory is sometimes said to be a limited case of a more general theory with greater accuracy. Typically, Newton's theory of gravity is said to be a limited case of Einstein's GTR [130]. Newton's theory is *useful* for making certain predictions and measurements across a certain range of scales because those particular kinds of measurements in those scales will produce results *close enough* to accurate *for practical purposes*. But the theory is still wrong in its explanation for those measures: gravity between bodies is not instantaneous and, according to GTR, gravity isn't even a force pulling on bodies [131]. Newton's theory of gravity is a wrong theory that provides predictions and results close enough to right for practical applications; so, despite being the wrong explanation of gravity, Newton's theory is still useful and retained in physics [132]. Likewise, the theory of element formation in stars, now well-supported, was a prediction of the debunked Steady-state cosmology [133]—again, a wrong theory yielding right predictions.

To science outsiders, it may seem nonsensical to retain a theory known to be false. Outside innovators want theories to be not just useful but also true. Most outside innovators believe that once a theory is shown to be false in some aspect, the theory must be abandoned for a better theory, even if it means changing the whole paradigm.

But that is contrary to standard practice in science, especially physics, which is inherently conservative. Even if a theory is shown to be wrong in one area of physical inquiry, physicists may just keep it anyway as long as it keeps giving correct measurements and predictions in another area. Physicists don't abandon a wrong theory until they have a better one to replace it—*even though they know the theory is not entirely correct*. And even then, they sometimes hang on to the wrong theory anyway for its usefulness in certain limited domains of measurement.

While that approach is practical for the continuity of conducting science as a discipline, the fact remains that theories such as Newtonian gravity are still flawed as models of physical reality when you get down to the details of what the theories claim. Newton's notion about how gravity works—by instantaneous force tugging on celestial bodies—is incorrect. Likewise, relativity and certain portions of quantum physics, despite all their hype as representations of reality, are also approximations that break down in certain areas and so are wrong models that in certain domains produce the right results. Hence, they too cannot be final theories. Which suggests that even a well-established scientific theory is still a *theory*, not a fact, and a theory can change. There is thus still some room for doubt about certain portions of the mainstream theories so popular today—including the Big Bang, spacetime relativity, various interpretations of quantum mechanics, etc.—all laden with physics weirdness [134]. So the need for theories not just useful but also true inspires outside innovators to seek out and propose less weird and more plausible theories of nature.

In short, what motivates aspiring outside innovators to search for alternatives to standard physics weirdness is the assumption that there must be more plausible alternatives to such. Such an assumption is supported by the very features of mainstream scientific theory itself:

- the tentative nature of scientific theory
- the fact that popular theories may later be revealed as flawed
- the mainstream's reliance on untestable sci-phi interpretations for weird theories
- the dubious apologetics for conventional physical theories, especially weird ones
- the mainstream's continued reliance on useful theories based on wrong explanations

Those features of scientific theory lend credence to the possibility of unconventional, yet more plausible, conjectures than the weird theories supported by mainstream physics. That is what motivates many outside innovators to propose sci-phi speculations and, unfortunately, instances of ironic science as well. In fact, such was behind my own creation of CSM.

The Quixotic Publications of Outside Innovators

When outside innovators or scientific philosophers believe they find some more plausible alternative to the concordance cosmology, or relativity, or quantum mechanics, then naturally some of them will want to share what they find, perhaps via publication—especially if they are confident (or overconfident) of their conclusions. That too was certainly the case for me when I offered CSM in *The Cosmic Sphere*. There is a problem with unconventional proposals offered by outsiders to the scientific community—such proposals tend to be the product of the scientific naïveté that comes along with being a science outsider, and especially of working in near isolation. That also describes my own case with *The Cosmic Sphere*'s publication.

Even if the outside innovator correctly intuits something wrong with a mainstream scientific theory, they do not necessarily have the right approach to come up with a plausible alternative. And even if the conception of their nonstandard cosmology or work of dissident physics has merit, it is unlikely to be scientifically rigorous enough to withstand the kind of skepticism that would be leveled at it from professionals in the field. Further, the scientific naïveté of the aspiring outside innovator tends to be evident, with their proposals all too often being scientifically untestable or unable to be differentiated from the results of tests supporting more mainstream theories. Hence, the naïveté of aspiring outside innovators is found in the implausibility and lack of scientific rigor of their proposals, and often their inadvertent promotion of ironic science.

The same naïveté is, I believe, also responsible for certain eccentric traits that some outside innovators may share with many exoheretics [135]. For example, a propensity to complain about the conservative nature of the scientific peer review process [136] or even accuse the scientific community of being mired in group think. I too engaged in some of that erroneous rhetoric at the tail end of *The Cosmic Sphere* [137]. Such charges come from not being sufficiently familiar with how science operates as a social activity among professionals in the scientific community.

One of the most eccentric traits that outside innovators share with exoheretics, though, is the naïve belief that publishing their work will directly impact the scientific community. At best, the impact of outside innovators on the course of scientific thought is likely to be indirect. For the most part, publishing sci-phi speculations, dissident physics, etc. will not garner positive attention from the scientific community even if the publication is widely noticed in the public sphere. As Friedlander mentioned [138]:

> Scientists do not greet with respect every putative revolutionary science that is announced. At one time, of course, major scientific ideas first appeared in books—Galileo's *Two Chief World Systems*, Newton's *Principia*, and Darwin's *Origin of Species*. None of these monumental works received peer review, none had to survive editorial scrutiny by a professional scientist…Those days have long gone. Scientists now view with great suspicion virtually any book in which remarkable claims are made for the first time, as they generally consider this a sign of unscientific eccentricity…Professional journals carry weight; press conferences and trade books do not.

That's a warning I could have used before I wrote *The Cosmic Sphere*.

However, defenders of mainstream science are not always correct in their assessment of what *motivates* outside innovators to publish. When they publish on non-mainstream platforms, outside innovators are sometimes, like exoheretics, accused by the mainstream of attempting an "appeal over the heads of the scientists to the general public" in order to falsely pass off their unconventional works as genuine scientific breakthroughs or win a debate with the field's professionals [139]. While that may be so for many exoheretics pushing various types of pseudoscience, I don't think that typifies what all outside innovators are up to, even if what they publish ends up to be ironic science.

Instead, many outside innovators I wager are looking for a receptive audience for a contribution to culture, but not necessarily for the purpose of socially pressuring scientists to change paradigms. Rather, I suspect most outside innovators are hoping to inspire the *next* generation of scientists to think outside the box with the nonstandard views that the innovators sincerely believe are likely closer to the truth than the standard theories so popular in the mainstream science of the day. The outside innovators are attempting to become the next Democritus or Kant rather than the next Velikovsky. At least, that describes my motivation for publishing *The Cosmic Sphere*.

6. On Publishing *The Cosmic Sphere* and Other Sci-phi

Unlike Democritus and Kant, I certainly did not succeed in offering a speculative model of natural phenomena holding any scientific promise. CSM died a quiet death as a result. It's a common fate of works by outside innovators. Most nonstandard cosmologies and works of dissident physics do not get noticed by the scientific community. Nor should they. Since even most mainstream theories in science lead nowhere, it is little wonder that outsiders to the scientific community barely ever offer a promising lead to further science [140]. Perhaps before the 20th Century, they occasionally did, but hardly at all in the modern era of science [141]. And let's face it: no contemporary philosopher is *likely* to be the next Democritus or Kant.

So, should speculating about the Cosmos be left *only* to the scientists? Not necessarily.

Scientists don't have a monopoly on speculation concerning the Cosmos. The domain of the scientist is what can be *physically observed, measured, and empirically tested*. That domain is not as large as the Cosmos itself (no matter what you might hear from pop cosmologists). Moreover, one could argue that the degree to which speculations are not likely to become testable hypotheses is the degree to which scientists are actually practicing philosophy (at least, of the speculative tradition), even if they pass it off as 'science'.

Then too, holding that only scientists should speculate about the Cosmos assumes speculation about the Cosmos must be done for the sake of advancing science. But outsiders are not obliged to advance science. Besides, there are limits to what science can observe and test [142], and our notions of the Cosmos need not be so constrained.

Instead, perhaps for those who are outside of science professions, the activity of speculating on what science uncovers of the Cosmos (in other words, the practicing of sci-phi) should not be about offering proposals for better scientific hypotheses or theories. Indeed, maybe sci-phi as offered by science outsiders should not be about trying to advance science at all. Perhaps sci-phi per se is not even about advancing human *knowledge* of the Cosmos. Rather, a more apt view is that sci-phi is about exploring *possible interpretations* of the Cosmos and seeking to discern *the most plausible interpretation* of what science has uncovered—to come up with interpretations that are the best candidates for personal *belief* in those domains where facts are likely to remain elusive and factual *knowledge* appears to be unobtainable.

With that orientation, I no longer consider it appropriate for outsiders to the scientific community, however well-informed on the subject matter, to publish sci-phi directly for the consideration of scientists. Those without proper science credentials who do not “speak the language” of the science professional with the “pitch of professional excellence” while proposing a nonstandard theory—in other words, those who are not endoheretics (and ergo insiders to the scientific community) [143]—should not be publishing their sci-phi in an attempt to influence the scientific community. Anyone passionate that mainstream physics weirdness is the wrong paradigm, but not interested in actually becoming an endoheretic of science, should just cease and desist trying to influence the scientific community, either directly in the present or indirectly in the future. While there is always room for novel sci-phi to make a mark on the culture, I recommend the scientific philosopher—lay or professional—let go of any aspirations to become an *outside innovator of science* and forgo attempts to impact the course of science as an outsider. Instead, I recommend the scientifically well-informed layperson—whether engineer, software developer, mathematician, philosopher, etc.—simply pursue sci-phi and leave the science to the scientists.

There are good reasons for this position.

First, if scientists want the opinion of an outsider to their community, they’ll ask for it. Scientists have their own research interests to pursue and their own sci-phi speculations to promote. Kindly leave them to it.

Second, works of sci-phi appear eccentric to scientists when they are pitched as attempts at *science*, even if they are not so eccentric when offered to outside seekers as simply the sci-phi they are—works of untestable, philosophical speculation concerning scientific observations. In other words, modern-day metaphysics. Perhaps interesting, perhaps inducing wonder, perhaps inspiring, but not provably true or false. As such, sci-phi is outside the domain of science and should not be presented as if it is science.

I suppose I should caveat that in making a case for the practice of sci-phi by outsiders to science itself, I am not advocating for a sci-phi counterculture to compete with science [144]. Rather, science should pursue its own paradigms and if perchance some scientist notices a work of sci-phi by an outsider and is inspired to come up with a similar conjecture that is an actual, testable hypothesis that proves to be true, well that’s just icing on the cake. All on its own science should *converge with* promising sci-phi proposals the way science occasionally makes discoveries or inventions that mirror science fiction. But that inspiration should come as an *accident* of the scientist stumbling upon the sci-phi *of their own accord*, not by an unsolicited proposal on the part of the sci-phi speculator engaged in a quixotic attempt to influence mainstream science.

Bottom line: impacting science should not be the goal of sci-phi. Sci-phi is, after all, what we do concerning those aspects of reality for which science is *unlikely* to uncover the truth and mere interpretation is all we are ever *likely* to have. So, if you’re an outsider to the scientific community, but educated enough on science and wish to publish some plausible sci-phi, don’t do it to influence the course of science; simply do it for broader cultural enrichment.

7. Beyond *The Cosmic Sphere*

With respect to any further sci-phi publications of my own, I will be taking some hard lessons learned from my experience with publishing *The Cosmic Sphere*. For one thing, I will follow my own advice: anything further that I end up publishing on a scientific subject will not be for the approval of the scientific community [145]. I may publish *about* science—even about what would be of benefit to science—but I will not be publishing *for* science. That is to say, I will not be publishing for the attention of professional scientists or with the aim of influencing the direction of scientific research. In the unlikely event that any of the professionals should read my work, that would be great, but that's not for whom I will be writing any works pertaining to science or cosmology.

For that reason, I will not be publishing a nonstandard cosmology or dissenting view regarding scientific theories in a science press of any kind, not even a fringe press or open source science journal. I will most definitely not be making any unfounded claims of scientific testability for my speculations, or their potential usefulness for conducting scientific investigation or leading to new technologies. I am long past promoting ironic science.

On that note, to further avoid practicing ironic science, or any other brand of pseudoscience, I will be implementing the following, which I advise to any other scientific philosophers:

> First, *temper skepticism of mainstream physics weirdness*. While I remain skeptical of *some* of the mainstream physics weirdness, I am not skeptical of *all* the things in science I previously thought too weird to be true. I do accept a great deal more of the cosmological weirdness, relativity weirdness, and quantum weirdness as settled matters in the mainstream's favor than I did before. And of those aspects of mainstream theory I remain skeptical about, I am not still skeptical for all the same reasons I was during my first foray into cosmology. I would certainly not employ all the same arguments I did against mainstream theories as when I advocated CSM.
>
> Second, *do not be any more dissident than absolutely necessary in order to support a sci-phi conjecture*. There are yet a few areas where I disagree with the scientific consensus that a given aspect of a popular theory has been established as "fact." But I have gained a much better understanding of where theory can be contradicted without running into the genuine facts. I have also become much more knowledgeable about what kind of speculations to pursue in explaining the physical world and what kinds to avoid. I will certainly not be pursuing a nonstandard cosmology or dissident physical model in the same way as I did back when I wrote *The Cosmic Sphere*.
>
> Third, *stick mainly to those areas of physics where philosophers of science largely agree that the jury is not only still out, but also not likely to be brought in for a verdict*—those areas where theory is underdetermined, interpretations are still possible, and critical tests unlikely to emerge. Those are certainly the areas where sci-phi has legitimacy.
>
> Fourth, *label as nonscientific and nonstandard any speculation contrary to what the scientific community holds as the standard paradigm*. Any new cosmological model from this author will be identified both as unrecognized by the scientific community and as coming not from a scientist but from an unaffiliated philosopher, so readers can take it for what it is—an independent work of *philosophical speculation* regarding scientifically acquired observations and data [146]. In other words, purely a work of scientific philosophy, or sci-phi.

Rather than publish to gain a hearing with the scientific community then, my next sci-phi work will be for the consideration of scientifically-informed lay seekers and the community of academic philosophers and philosophy students—in particular, those in the speculative tradition, or at least those interested in philosophy of science (the analytic tradition). For they are the ones interested in new, nonstandard views of the Cosmos and it is they who will be in a position to in turn inspire the next generation of philosophers to come up with yet new, creative ways of interpreting the Universe in those areas of inquiry where the scientific facts remain ever elusive and the scientific consensus remains more a matter of belief than knowledge.

Notes

[1] Sewell 1999.
[2] Cosmology became widely recognized as part of physical science in 1948 when the Big Bang theory was further developed with testable predictions and the original Steady-state theory challenged the Big Bang with testable predictions of its own (Kragh 2015, p. 122– 123). But cosmology was also considered a subfield of philosophy—at least, until 1960 when cosmology began to be regarded across academia as more a branch of science than philosophy (Smeenk and Ellis 2017). Given the speculative nature of cosmology (Kragh 2015, p. 117), I consider cosmology to still overlap with both science and philosophy (which is supported in the preface to Kragh 1996, p. *ix*).
[3] Hossenfelder 2022, p. 30 and its footnote.
[4] Smolin 2017, pp. 4–5.
[5] Rovelli 2017, pp. 147–148.
[6] For the contradictions between relativity (Einstein's theory of spacetime) and quantum mechanics (which assumes Newton's theory of space and time), see the following:
(a) Einstein 1954, p. 318.
(b) Isham 1992, p. 161. See pp. 5 and 108 of preprint online:
<https://arxiv.org/abs/gr-qc/9210011v1>
(c) Penrose 2004, p. 609.
(d) Macías and Quevedo 2006.
(e) Smolin 2019, pp. 229-230.
(f) Baggott 2020, pp. 50, 195.
[7] For quantum gravity as a solution to the contradictions between relativity and quantum mechanics, see the following:
(a) Isham 1992, preprint pp. 107–108.
(b) Smolin 2017, pp. 4–5.
(c) Rovelli 2017, pp. 149.
[8] See the following:
(a) Greene 2003, p. 4.

(b) Smolin 2017, Chapter 10 (for loop quantum gravity) and Chapter 11 (for string theory): pp. 125–166.

[9] For string theory and loop quantum gravity as competing approaches to reconcile the contradictions between quantum mechanics and relativity, see the following:
(a) Greene 2003, pp. 3–4; 141–158; 164–165.
(b) Smolin 2006a.
(c) Rovelli 2017, pp. 160.

[10] Smolin 2017, p. 5.

[11] Sewell 1999, pp. 391–400; 417–418.

In *The Cosmic Sphere*, I assumed the accuracy of certain plasma cosmology claims by physicists Hannes Alfvén and Eric Lerner (see Lerner 1991), as well as the interpretation of quasar redshifts by astronomers Jayant Narlikar (1991) and Halton Arp (1994), and the iron whisker reinterpretation of the cosmic microwave background by Arp et al. (1990). However, I have since abandoned these views in light of further evidence that has emerged against them from mainstream sources.

That said, I do not entirely eschew all dissident physics. For instance, I'm still skeptical that the Universe as a whole is expanding as maintained by the concordance cosmology and so I must still support an alternative interpretation of the cosmological redshift. The alternative cosmological redshift explanation I currently subscribe to is based on a variable mass hypothesis (similar to, but by no means the same as, that in Narlikar and Arp 1993 & 1997). The notion of variable mass I have in mind differs from theirs in that it has nothing to do with claims of redshift periodicity (Narlikar and Arp 1993; Arp 1994), of which I have become increasingly skeptical.

[12] No material body can be older than the Universe itself, but scientific measurements have repeatedly indicated that there exist material bodies older than the age of the Universe as estimated by the latest version of the Big Bang theory. This evidence throws the Big Bang into doubt. In the early 1930s, measurement of the Hubble constant (speed of expanding space) indicated the Universe to be younger than the geological estimate for the age of the Earth. In the late 1950s, the Hubble constant was re-estimated and found to exceed the age of the Earth, thus temporarily resolving the problem. But then from the late 1970s to the mid-1990s, astronomical age estimates for the Universe again placed it as less than the age of the oldest stars it contains. Astrophysicists adjusted their models of stellar formation and the problem was again apparently solved. Or so scientists thought until the 2010s when the age paradox returned and, as of this writing, it is still not entirely resolved. See Crookes 2022.

[13] Boslough 1992, pp. 218–221.
[14] Einstein 1917, pp. 429–432.
[15] Sewell 1999, pp. 77, 91–92.
[16] Sewell 1999, p. 138.
[17] Sewell 1999, pp. 157, 161, 163, 169–171.
[18] Sewell 1999, pp. 381–382.
[19] Sewell 1999, pp. *xix*, 194; 198–199; 382; 399; 436–437; 450.
[20] Sewell 1999, pp. 198–199; 436.
[21] Sewell 1999, pp. 194; 381–382; 436.
[22] Sewell 1999, pp. 169–171.
[23] Sewell 1999, pp. *xxx*, 404.
[24] Berryman 2016.

[25] Kant 1755, pp. 220–221; 261–262; 264.
[26] Sewell 1999, pp. *xxvii*, *xxix*, 404–405.
[27] I am not the first to use the abbreviation 'sci-phi' or variations thereof. Other uses of sci-phi (also 'sci phi' or 'sciphi' or 'SciPhi') include the following:

- *Sci-Phi*: A 1998–2013 philosophy of science column in written by Mathew Iredale for *The Philosophers' Magazine*. As an example, see Iredale 2004.
- *Sci-Phi*: The title of a non-fiction book that examines philosophical ideas as plotlines in science fiction stories (especially, science fiction movies). See Rowlands 2005.
- *Sci-Phi: Science Fiction as Philosophy*. An online lecture course about science fiction movies and television shows the plots for which are based on philosophical positions. Online source: <https://www.kanopy.com/en/product/5817339>
- *Sci-Phi Show*: A weekly podcast that discusses philosophical ideas presented in science fiction TV shows, movies, or short stories. Online source: <https://www.podchaser.com/podcasts/the-sci-phi-show-122196>
- *Sci Phi Journal*: An online magazine and internet platform that presents works of fiction based on speculative philosophy, cultural anthropology, and science. Online source: <https://www.sciphijournal.org>
- *sciphi*: The domain name of the Science and Philosophy Seminar, a series of online meetings that explores and discusses "a wide array of topics, ranging from philosophical speculation to scientific research." Online source: <http://www.sciphi.org/index.html>
- *SciPhi*: SciPhiWeb is a scholarly journal "curated as a repository of plural reflections and research in gaming, scientific and philosophical cultures." Online source: <http://www.sciphiweb.com>

Those are hardly exhaustive of the uses of the abbreviation or its variations. Just for clarity, I am not affiliated with any of the above, so any views expressed by those sources are not necessarily reflective of my own. My use of 'sci-phi' is distinct from their various uses of the abbreviation.

[28] In fact, "A Scientific Reformation" was the subtitle of *The Cosmic Sphere*.
[29] Sewell 1999, p. *xxx*.
[30] In addition to CSM's conceptual and factual errors, the book also contains some errata (for example, all the figures from 20.14 to 20.21 are off by one number and some figure and table captions are incorrect). Though the mistakes are mine, their appearance in the book was also the consequence of publishing via a low-tier trade division lacking proper editorial oversight. Lesson: be careful with whom you choose to publish.
[31] Gordin 2021, p. 41.
[32] Of the pseudosciences, I distinguish between 'ironic science' (see endnote 51) and 'pathological science', the latter term coined by Irving Langmuir (1881–1957), an American chemist, physicist, and engineer. See Langmuir 1953.
[33] Skordis and Złośnik 2021.
[34] Penrose 2010.
[35] On the acceptance of germ theory, see Harvard Library 2018 and Radner & Radner 1982, pp. 18–21. On the acceptance of continental drift, see Britannica Editors 2021, Conniff 2012, and Radner & Radner 1982, pp. 88–92.
[36] Gray 2017.
[37] Smith 1983, pp. 45, 51.
[38] Smith 1983, p. 51.

[39] Center for History of Physics, 2022.
[40] Smoot and Davidson 2003, p. 671.
[41] University College London. (2012).
[42] For example, theoretical physicist Paul J. Steinhardt. See Ijjas and Steinhardt 2019 and Horgan 2017.
[43] Regarding astrobiology and SETI: I do not mean that theories of extraterrestrial life are fringe. Rather, I mean the search for signals from extraterrestrial civilizations is fringe.
[44] Friedlander 1998, pp. 27–34.
[45] Andersen et al. 2015.
[46] Sewell 1999, pp. 228–231; 391–400; 417–418. (See also endnote 11 in this article.)
[47] I am thinking specifically of the following:

- The alternative atomic model of Dewey B. Larson
- The plasma cosmology of Alfvén and Lerner
- The theory of redshift periodicity by Narlikar and Arp.

Regarding Larson, there are two points to make.

First, it's not clear to me how Larson should be classified. He was certainly a dissident physicist, but some considered him to be a fringe scientist insider while others see him as a pseudoscientist outsider.

In favor of the view that Larson was a fringe scientist insider, here is what one physicist reviewing Larson's book about the nuclear model of the atom had to say: "Mr. Larson shows himself to be well-informed on the current status of physics research and there is very little in the book that is factually wrong." –R. D. Redin, Department of Physics, South Dakota School of Mines and Technology, review of *The Case Against the Nuclear Atom* in *Chemical Engineering*, 22 July 1963.

Moreover, according to Isaac Asimov's description of the non-credentialed 'endoheretic' (see endnote 78), Larson would qualify as a scientific community insider, albeit a failed endoheretic. (See Asimov's review of *The Case Against the Nuclear Atom* in *Chemical and Engineering News*, 29 July 1963. Online source: <https://rationalwiki.org/wiki/Reciprocal_Theory>.)

On the other hand, if one looks at Larson's whole body of work (see Natural Philosophy Wiki contributors 2016), he seems to qualify as a pseudoscientist outsider. He promoted his Reciprocal System of Theory as offering a scientific revolution but his system was mostly a combination of unpromising fringe science, ironic science, and some outdated scientific data. While he still has supporters (as naïve as I was back when I wrote *The Cosmic Sphere*), the mainstream dismisses Larson.

Second, and on that point, I no longer agree with Larson's case against the nuclear atom. There may be more to the atom than the mainstream allows today, but Larson's alternative to the standard nuclear model of the atom is not tenable. The mainstream is right to dismiss his work.

Regarding the plasma cosmology (Lerner 1991) and the redshift periodicity (Narlikar and Arp 1993; Arp 1994), those too I no longer hold to have any merit. That's not to say there isn't a role for plasma physics to play in cosmology or no other way of interpreting cosmological redshifts, but they are not to be found with these approaches.

[48] I am assuming that a *statement* can be true or false even if it cannot be known or confirmed as such.
[49] Sewell 1999, p. 402–403.

[50] Sewell 1999, p. 405.
[51] Horgan 2015a, pp. *xxi*, 24 and Horgan 2015b.
[52] See Wertheim 2011 and de Climont 2016.
[53] This categorization of pseudoscience is a modification of the pseudoscience categorization schema proposed by historian Michael D. Gordin. See Gordin 2021, p. 14.
[54] See endnotes 32 and 51.
[55] Horgan 2015a and Horgan 2019, pp. 87–88. See also Horgan 1996, p. A17.
[56] Horgan 2015a, pp. *xxi*, 24, 54.

My take is that philosophy is not science and panpsychism is, simply as such, not a scientific speculation at all, but rather a metaphysical—ergo, purely philosophical—speculation. A better example of ironic science is a related sci-phi conjecture called integrated information theory (IIT). See Koch 2019.

[57] Carrier 2014, Slide 29.
[58] Horgan 2017. Compare with Horgan 2011.
[59] Horgan 2015a, pp. 24 and Horgan 2019, pp. 87–88.
[60] ‘t Hooft 1997, p. 61.
[61] ‘t Hooft 1997, p. 61.
[62] Bejan and Zane 2012.
[63] See endnote 19.
[64] The “best obtainable version of the truth” is a description of the goal of good journalism according to Pulitzer Prize-winning journalist Carl Bernstein, but it could just as well be said of science’s goal. See Harbrecht 2019.
[65] Some scientists say theories don’t *become* facts but rather that theories only explain facts. However, this is only half true. We need to distinguish between two definitions of the word ‘fact’—let’s call them $fact_1$ and $fact_2$, defined as follows:

- $Fact_1$: *the existence of a state of affairs as represented by a true and confirmable or confirmed statement*.
- $Fact_2$: *a true and confirmable or confirmed statement about an existing state of affairs*.

It is true that theories explain previously unexplained $facts_1$ and it is also true that in the *technical language* of science, theories don’t *literally* become $facts_2$. However, in the *ordinary language* of science, theories figuratively “become” $facts_2$ when what was previously regarded as a theory is later shown to be true and confirmed. You could more literally say the content of the theory is established as a $fact_2$. Not only did the theory explain the given $facts_1$, but the explanation itself becomes a new $fact_2$ about the $facts_1$ explained.

[66] Gorvett 2021.
[67] Some scientists say that science is whatever scientists say it is. But then, philosophers could make the same claim of philosophy. So is philosophy whatever philosophers say it is? If so, does that mean if a philosopher were to conduct experiments and call it “philosophy,” then it would be philosophy? After all, such activity used to be just that. At one time the sciences were considered just branches of ‘natural philosophy’. The title of Isaac Newton’s 1687 scientific treatise was *Philosophiae Naturalis Principia Mathematica* (*The Mathematical Principles of Natural Philosophy*). But philosophy and science have become epistemologically distinct since then. I don’t think it’s very useful to think of science as what scientists do any more than it’s useful to regard philosophy as whatever philosophers do.

Both scientists and philosophers form conjectures, but the kind of conjectures they make differ as does their manner of putting their conjectures to the test. Scientists hypothesize and theorize; philosophers speculate. There is, however, some overlap in that activity. Conjecture on scientifically acquired facts and data, if it is not testable, is not science; rather, it's just interpretation or speculation—a form of philosophy; in particular, sci-phi or modern-day metaphysics. If a conjecture is in actual practice *systematically* testable with empirical consequences, then it is more than just speculation and may qualify as an instance of science. Philosophers, on the other hand, do not tend to empirically test their conjectures—they must instead rely on 'thought experiments' and arguments, which are waters scientists are increasingly wading into under the guise of science—ironic science.

[68] Horgan 2015b.
[69] Horgan 2015b.
[70] 't Hooft 1997, p. 163.
[71] Horgan 1996 and Horgan 2015b.
[72] In the primary literature, articles on string theory appear in scientific journals such as the *Journal of High Energy Physics*, *Nuclear Physics* B, *Symmetry*, etc. In the secondary literature, articles on string theory appear in *Scientific American*, *Discover*, and other science periodicals you can find on magazine racks.
[73] For example, consider philosophical thought experiments in the study of ethics, such as those illustrating moral dilemmas from conflicts between intention and foresight. See the following:
(a) Foot 1978.
(b) Thomson 1976.
(c) "The Trolley Problem." Season 2, Episode 5 of *The Good Place*, Dir. Dean Holland. Josh Siegal & Dylan Morgan (Producers), 19 October 2017. Television. Online source: <https://www.youtube.com/watch?v=JWb_svTrcOg>
[74] Horgan 2015a, pp. *xvi–xvii* and Horgan 2015b.
[75] Baggott 2013. Caveat: Baggott would say that loop quantum gravity is the better idea that not only should replace string theory but he is convinced it is genuine science (see Baggott 2018). I, to the contrary, do not agree that loop quantum gravity is markedly different from string theory with respect to scientific status—both are instances of ironic science.
[76] Horgan 1996, 2015a, 2015b.
[77] Wolfram has not published his theories in academic journals since the mid-1980s. However, he has the credentials to do so. See Wolfram 2020.
[78] Asimov 1983 (1997 edition), pp. 50–52.
[79] Asimov 1983 (1997 edition), pp. 50–52.
[80] Asimov 1983 (1997 edition), pp. 51–52.
[81] Asimov 1983 (1997 edition), pp. 50–53.
[82] Asimov 1983 (1997 edition), p. 52.
[83] Einstein 1920, pp. 39–40, 61–63 .
[84] Wittgenstein 1936–1949 (2009 edition), §§ 23, 97, 114–116, 371, 373.
[85] See the following:
(a) Einstein 1917 (1952 translation), pp. 430–432.
(b) Einstein 1922 (1970 edition), p. 65.
(c) Moskowitz 2010.
[86] Wittgenstein 1922 and Wittgenstein 1936–1949 (2009 edition).
[87] Sewell 1999, pp. *xiv–xv*.

[88] In fact, “scientific reformation” rather than “scientific revolution” was part of the book’s subtitle.

[89] Sewell 1999, pp. *xxx*, 405–406.

[90] “Science (Latin *scientia*, knowledge) is based on knowledge…A scientific theory is not ‘just’ a theory; it represents a very high level of knowledge acquisition.” (Carter 2007, p. 194.) To which I say…theories may *assume* knowledge, they may be *grounded upon* facts, but theories are not themselves known to be true or false, nor are they themselves facts, regardless of how much the theories are believed in. A theory known to be true is no longer a theory—it has transformed in epistemic status to become a fact.

[91] Ellis and Silk 2014.

[92] Jones 2017.

[93] Horgan 2017.

[94] Horgan 2015a, p. 110.

[95] For the issue of assessing evidence regarding measurements of one-way and two-way speeds of light, see the following:
(a) Tooley 1997, pp. 340–342; 348–350; and 357.
(b) Dainton 2014, p. 338.
For a theory that light speed varies over time, see Magueijo 2003.

[96] It has become typical to find defenders of mainstream science using pejorative labels such as *crank*, *crackpot*, and *kook* not only for exoheretics but also for outside innovators and sometimes even for well-credentialed endoheretics. The use of such pejoratives is not an argument against the positions of those who challenge a mainstream theory or paradigm, but rather it is an assessment of the challengers themselves, employed as a political strategy to either silence them with ridicule or convince others to dismiss the challenger outright.

Some defenders of the mainstream also use humor as a strategy for dismissing a challenger. For example, take the crackpot index: <https://math.ucr.edu/home/baez/crackpot.html>. Such tools are not instances of serious epistemology. Rather, they are purely rhetorical devices used for dismissing an opponent or would-be rival rather than engaging them. (Imagine philosophers dismissing mainstream cosmological proposals such as inflation or the Multiverse by appealing to a sophistry index or fallacy meter.) It’s clear to see such rhetorical devices should not be taken seriously.

Don’t get me wrong: not all mainstream science challenges deserve a hearing. Some are, quite frankly, psychotic and should be ignored (as mentioned in Horgan 2011). It’s just that the use of pejoratives or humorous rhetoric to attack mainstream science challengers is not always an indication that a given instance of mainstream opposition is wrong (see endnote 98), and smiting mainstream challengers with pejoratives or ridicule can occasionally even be a sign that the mainstream defender doth protests too much. A more rational response for the mainstream defender is to either point out why the contrary position of their challenger is incorrect or simply respond to their challenger with silence.

[97] For some examples from physical theory, see Kragh 2015.

[98] Here are a few examples of endoheretic scientists from across several fields who were ridiculed by their colleagues in the mainstream for promoting contrary fringe theories but were later vindicated, overturning the paradigm of their former critics:

- Charles Darwin (1809–1882) for his theory of evolution
- Ludwig Boltzmann (1844–1906) for proposing the existence of atoms
- Alfred Wegener (1880–1930) for proposing continental drift

- Robert H. Goddard (1882–1945) for the idea of rockets to space
- Barbara McClintock (1902–1992) for proposing the existence of transposon genes
- Lynn Margulis (1938–2011) for proposing endosymbiotic organelles

And that's just to name a few. Though they were all eventually vindicated, if ridicule is the initial reception that endoheretics receive as science *insiders*, then just think how the mainstream is likely to receive *outside* innovators and their dissident proposals.

[99] For an example, see the comments about Einstein's General Relativity in Fish 2019.

[100] Horgan 2015a.

[101] See endnote 64.

[102] Horgan 2015a, pp. 51–52.

[103] Greene 2003, p. 14.

[104] Wilczek 2008.

[105] "'We basically think of a particle as a pointlike object,' said Mary Gaillard, a particle theorist at the University of California, Berkeley who predicted the masses of two types of quarks in the 1970s." (Quote in Wolchover 2020). With a caveat: "The quarks, leptons and bosons of the Standard Model are point-like particles. Every other subatomic particle you've heard of is an extended particle." (Quote from Lincoln 2013).

[106] Herbert, Nick. (1987).

[107] Just a couple of the more recent quantum interpretations are QBism (von Baeyer 2013) and the Transactional Interpretation (Cramer 2016).

[108] Wetterich 2013 and Heidelberg University 2014.

[109] Cartwright 2013, Koelman 2013, and Yo 2017.

Caveat: some defenders of the concordance cosmology have attempted refutations of this alternative cosmological model, but I have so far found their refutations to be based on circular reasoning, fallacious straw figure arguments, and irrelevant ad hominem slurs (e.g., Cain 2015). Don't get me wrong: I do not believe that all matter in the Universe is shrinking while the size of the Universe as a whole remains static. Rather, I'm simply pointing out that those who instead assume matter stays constant in size while space expands have not to my knowledge made good arguments against the contrary cosmology.

[110] See endnote 25.

[111] As an example of an outside innovator attempting (whether successful or not) an alternative theory intended to be less weird than a mainstream physics theory, see Boyd 2012.

[112] Jennings 2013.

[113] Friedlander 1998, p. 63.

[114] Radner & Radner 1982, p.22.

[115] For example, see theoretical physicist Leonard Susskind's response to science journalist John Horgan's article about physics weirdness as having strayed too far from a common scientific view of reality: Horgan 2005.

[116] Two examples:
(a) Rosenblum and Kuttner 2011.
(b) Cramer 2016.

[117] Bergson 1922 (1965 edition).

[118] Sewell 1999, Ch. 19: pp. 345–374.

[119] Two good examples from the book include a critique of particle collision interpretations and a critique of virtual matter as particles that pop in and out of existence: Sewell 1999, pp. 313–318.

[120] Simanek 2012.
[121] Shermer 2012.
[122] Shermer 2012.
[123] Simanek 2012.
[124] Simanek 2012.
[125] Simanek 2012.
[126] Gilbert 2020.
[127] Wilczynska et al. 2020.
[128] Smolin 2006b, pp. 125–153, and Baggott 2013, p. 145.
[129] See the following:
(a) Gjertsen 1989, p.253
(b) Strevens 2020, p.90.
[130] Ryden 2017, p. 27.
[131] Carroll 2016.
[132] Ryden 2017, p. 27.
[133] Peebles 2020, p. 349.
[134] Sometimes, theories require some philosophical skepticism. Many independent researchers specializing in other fields such as philosophy may not be able to critique the scientist's use of mathematics, their use of equipment, or the measurements they make to test a theory, but the philosophers can still critique the *assumptions* and *reasoning* the scientific theory rests on. Of course, the philosopher must be cautious and not too overconfident. But with the aid of knowledgeable science insiders, the philosophers may have some valid critiques of physics weirdness.

Just because scientists consider a matter *scientifically* settled does not mean philosophers are rationally obliged to agree they are *philosophically* settled. Scientific theory does not always entail scientific knowledge. There are still some popular theories underdetermined by the scientific evidence and that consequently may still be epistemologically dubious and could end up overturned.

To the degree science must rely on indirect tests and tenuous observations is the degree to which speculation opens up with alternative possible explanations and interpretations. The most plausible candidates among alternative explanations and interpretations are those that tend to be the least weird. So, there is still room for innovative explanations of physical phenomena outside of the current paradigm of physics weirdness, explanations that may prove to be less weird than the mainstream consensus.
[135] Friedlander 1998, p. 58.
[136] It's fine for a scientist of prestige to complain about occasional peer review bias (for example, Smolin 2006b, pp. 333–334). But it's quite another for those outside the scientific community to complain about their work not receiving scientific publication due to biases in the peer review process, for that's most often a trait of the pseudoscientist (see Friedlander pp. 51, 58).
[137] Sewell 1999, pp. 404–406.
[138] Friedlander 1998, pp. 58, 160.
[139] Asimov 1983 (1997 edition), p. 52.
[140] That goes double for the exoheretics. "The endoheretic is sometimes right, and, indeed, since startling scientific advances usually begin as heresies, some of the greatest names in science have been endoheretics…the exoheretic, on the other hand, is virtually never right,

and the history of science contains no great advance, to my knowledge, initiated by an exoheretic." Quote from Asimov 1983 (1997 edition), p. 53.

I would only counter that it depends on who you want to count an endoheretic (as opposed to an exoheretic—see the next endnote).

[141] Occasionally, you may hear some of today's scientists refer to an ancient philosopher who had proposed a surprisingly accurate explanation for some natural phenomenon as having been a 'scientist' ahead of their time. Democritus, for example, is sometimes called a scientist for his proposal of atoms as the basic constituent of physical objects. However, I suspect that, in appropriating certain ancient philosophers as "the first scientists," today's scientists are attempting to bolster their prejudice that philosophy never had much to offer anyway—it's always been science that has explained the world, so there's no point in pursuing philosophy. Why do we need it when we have science?

But there is a problem with claiming some of the ancient philosophers to be 'scientists', as if bestowing upon them an honorary degree. Just because a philosopher's speculation turns out to be correct does not make the philosopher a scientist.

Democritus was correct about the existence of atoms—at least with respect to chemical elements being particulate in nature. But does that mean Democritus was by today's standards an endoheretic scientist of his time? Or was he a philosopher and therefore by the scientific standards of today an outside innovator, or even an exoheretic, who just happened to be right? Scientists may want to claim him as a historical predecessor, but he was also a philosopher and, arguably, he was acting as a philosopher in offering his speculation about atoms.

Rather than view science as having taken over from philosophy, I would offer that it is all too frequently the other way around—many scientists today are practicing philosophy (especially sci-phi) and passing it off as "science" when it is no such thing. To the degree that scientific views are not backed by observation or empirical tests, science hasn't replaced philosophy—it's just covertly carrying on philosophy under another name. There is, then, still room for philosophy to influence science, even if but narrowly.

[142] Ekeberg 2019, p. 6.

[143] Asimov 1983 (1997 edition), pp. 50–52.

[144] White 2014, pp. 214, 217.

[145] Friedlander 1998, p.58.

[146] Though my next cosmological model will be sci-phi, it will still be supported by scientific data and observations—established facts—even if not consistent with the hypotheses or theories upon which those observations were made. That much of my project will not be different from my development of CSM. What will be different going forward is the following:

(1) The audience addressed—philosophers and lay seekers rather than scientists.

(2) The set of scientific observations and theories the new cosmology will draw from—avoidance of outdated fringe theory.

(3) The mainstream theories I accept or reject (I now have a better notion of what is still questionable in science and what is settled, which will make for an improved sci-phi).

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Erratum: *An earlier version of this article had two instances of "sci-fi" on page 16 that should have been "sci-phi". The typos have been corrected in the present version.*