Publication copy for *Yggdrasil: The Journal of Paraphysics* Copyright © 2007

An editorial!

No Braner Unification
with no strings attached
by James E. Beichler

The senses and sensibilities of everyone who is interested in science have been assaulted for the past several years now with fantastical stories that claim a TOE (Theory of Everything) called M-theory is near at hand. It is expected that this so-called TOE will evolve from a group of theories called superstrings and their offspring, brane theories. It is hard to find either a popular or a professional scientific periodical that has not included a glowing new story about branes or superstrings in the past few months, let alone the past several years, in spite of the fact that these theories are admittedly mathematical rather than physical and have never produced any scientific results or predictions that could possibly render them testable. In spite of such serious falsifiability issues, a very large number of scientists have become far too enamored with these theories for the wrong reasons. Liking a theory because of its mathematical beauty is different from accepting it as a physical reality; at least one would hope so.

Popularity is not and has never been a prerequisite for good science. However, many schools have begun offering courses in these theories as if they had already been verified and accepted, implying that their accuracy in modeling physical reality is a foregone conclusion. It is not. Unfortunately, offering regular courses means that superstring/brane theories have now been promoted to the status of a dominant paradigm and that a paradigm shift has occurred, at least according to Thomas Kuhn's characterization of a paradigm. Yet the only possible paradigm shift that could have occurred is not one that reflects the acceptance of these theories, it is a downward shift to a new low in the tolerance for accepting theories for other than scientific reasons. If so, this is an unfortunate occurrence for science that could presage a weakening if not a complete breakdown of the scientific method. Paradigm shifts are revolutionary events, but no revolution has yet occurred.

On the one hand, it is highly likely that science is presently on the verge of a new revolution out of which a new theory of physical reality will emerge. On the other hand, the M-theory that is pictured does not represent that theory, let alone a final theory of physics (whether one believes that a final theory is even possible or not). In fact, the superstring/brane theories should not even be considered contenders for a TOE until they have been falsified and verified at even the most rudimentary level, which they have not. Too many scientists and non-scientists are jumping the gun on this issue. The new revolution will come from another direction completely, while the branes and superstrings that are now so popular will eventually be relegated to the role of historical footnotes, as was the popular theory of vortex atoms just prior to the last scientific

revolution. Fortunately, what is true in science reflects nature and the natural world and thus nature decides the issues in science, but accepting the superstring/brane theories before their acceptance is justified with even the least of evidence will prolong and harden the revolution when it comes, more than would normally be necessary.

The fundamental nature of the objections to these theories and the reasons that they should be rejected outright unless they are immediately and completely verified should be quite obvious, but seem to have completely eluded the scientific community. These reasons do not especially follow from the well-known failure of these theories to provide the same simple falsifiability that is required of all theories, even though this too has been overlooked by far too many scientists. The reasons can be summarized within two broader categories: (1) The superstring/brane theorists suffer from a fatal case of the Cartesian Error Syndrome, and (2) these theorists have unwittingly destroyed the fundamental theories, postulates and assumptions upon which their own theories are based. In their ever-expanding efforts to directly connect with and absorb any and every other successful theory in physics, these theoreticians had stretched the credulity of their model beyond its furthest limits. In so doing, they have severed all ties between their theories and previous physical theories with which they may have had connections and thus with physical reality, at least in so far as our presently accepted paradigms and models of physical reality are concerned.

The Cartesian Error

It is bad enough that the superstring/brane theories are based upon such a speculative concept as higher-dimensional strings, for which no evidence has ever been developed or whose physical existence has never even been implied or suggested by anything in the scientific record, but newer speculations based upon the earlier speculations keep emerging, speculations by speculations upon new speculations. With superstrings, scientists have built an artificial theoretical edifice that has very little but more than likely nothing to do with the natural world and continues to move even further from reality. It is commonly known and accepted that any new theory is required to explain the successes of the older theories that it is replacing before that theory can be considered a viable possibility. In computer technology, this concept is called ‘backward compatibility’. In other words, a new theory must share some common points with previous science or at least be historically linked to previous accepted theories and paradigms. The superstring/brane theorists have put so many patches on their increasingly speculative models that the superstring/brane theories have been reduced to no more than a pseudo-scientific rag doll rivaling the greatest straw man any politician could ever build. The superstring and brane theories are no longer backward compatible with real science and their own theoretical roots.

Science, as we now regard it, emerged during the Scientific Revolution in the seventeenth century. Its successful evolution depended upon a strict separation of scientific concepts from religion and religious scholasticism. This separation was initially accomplished by René Descartes’ distinction between Mind and Matter and later reinforced by Isaac Newton’s objectification of science. According to Descartes, Mind was the realm of spirit while the laws of

nature came from God via Mind. Matter was created by God and the world of matter is governed by the laws of nature. Our material world was thus mechanistic in design. Descartes originated the concept of a mechanical worldview to explain the realm of Matter and Newton explained that mechanism. Matter became the realm of science and Mind was associated with God. Descartes was primarily a mathematician and a philosopher, but he was also the first person to distinguish between weight and matter and thus define mass. Yet he was unable to capitalize on this scientific advance and convert his notion of mass into a conceptual framework that would give him a correct theory of motion. Descartes allowed himself and his science to be guided by his 'a priori' or preconceived philosophical biases rather than depend on nature to guide his theoretical reasoning. His own wrong reasoning and philosophical bias thus forced him into a dead end when he tried to explain simple collisions between material objects.

In other words, Descartes thought that nature should act and react according to the philosophical principles that he had derived through Mind, betraying his faith in the mistaken principle that philosophy overrules nature rather than accepting the fact that science is derived from the observation and consequent explanation of nature. Any mental or philosophical scholasticism of this type can be regarded as a Cartesian Error. Unfortunately, this practice is still followed today and even advocated by a surprisingly large number of scholars and academics, who either act as if or completely believe that nature should act as humans think it should act and be what humans think it should be.

In just the last month, an article by the cosmologist Max Tegmark appeared in the popular scientific magazine *New Scientist* in which he makes the claim that mathematics, not the physical/material world that we experience, is reality. It would seem that mathematics is pure, pristine and exact while our theoretical models and the constructs by which we explain natural phenomena are products of the less precise logical system of language. This may well be true in a more narrow sense than Tegmark intended, but it is a long way from the claim, made by Tegmark and many other philosophers over the centuries, that mathematics rather than our experiences of the natural world are the reality. Tegmark offers no more than a modern form of Plato's 'forms'. While it would be interesting and informative to discuss the flaws in Tegmark's logic further, it should suffice at this point to just note that he is mistaking the finger pointing at the moon for the moon itself, another very old concept. Tegmark has merely derived a new argument in support of the Cartesian Error. He is abandoning science for a physical reality based on the philosophical scholasticism of mathematics.

Mathematics is just an abstract system that is based upon the logic of our mind and the basic postulates and theorems upon which Tegmark or anyone else would like to base physical reality, regardless of what nature dictates. But just because something can be described mathematically from basic postulates does not mean that it should be physically true. In science, nature decides the theorems and postulates upon which we develop the logical structures called hypotheses, models, theories, principles and natural laws. At best, mathematics can only point to logical possibilities while nature decides which possibility is best suited, through the observation, measurement and the experimental method, to truthfully and accurately describe physical reality. It is just this possibility that the superstring/brane theorists base any possible valid claims that

their theories represent reality, and then only the very slimmest of possibilities. If they try to claim any more than this, they are falling prey to the Cartesian Error Syndrome. And they surely do try to claim just this and more.

Quite frankly and with extreme emphasis, the superstring/brane theorists are guilty of the same mental and logical errors as Descartes. They have developed a very complicated yet purely mathematical model and have assumed its truthfulness with regard to nature without any reference to nature, except by simple (if not simplistic) analogy. They assume that their specialized mathematics, representing a purely philosophical system, should be the way that nature acts, but there is no substance to their claims. Since the realm of nature that they are investigating is so small as to be virtually if not completely beyond any possibility of observation, a measurement of some 'thing' far smaller than the proton (about 10^{20} times smaller than the width of a proton), they believe that they can merely assume the truthfulness of their basic hypothesis, the existence of strings. The simple fact that their hyper-dimensional strings are so far beyond the possibility of physical measurement or detection should not be an excuse for accepting superstring/brane theories without falsification.

Nor should it be used as an excuse for the theories to circumvent the normal standards of falsification. If we cannot detect the effects of the strings in our common world, then they are either non-existent or irrelevant to science. The development of the string hypothesis has led to new horrendously difficult mathematics and mathematical systems. In this respect, these theories may represent good mathematics and they may be philosophically beautiful to some scholars and academics, but they are shoddy physics and bad science. The superstring/brane theories present science with no more than a wishful 'what if' scenario. They do not represent true physical theories in so far as they are based upon the reality of strings and branes. In spite of this fact, superstring and brane theorists are sucking up time, finances and resources that are necessary elsewhere to do good and proper science.

Once, when illustrating the power of mathematics, George Gamow explained that it was possible to invent any universe desired by starting with the proper theorems, postulates and initial conditions. Our common universe of experience could even be turned inside out with mathematics. But mathematics, while used in this manner, is a double-edged sword that cuts both ways. Mathematics can only propose solutions and possibilities, it cannot be used to either absolutely determine or dictate reality. The beauty and logic of such mathematics can even mesmerize people and lead them away from natural truth, in spite of the logical truth of the mathematical system. This scenario exactly describes the superstring/brane issues.

According to a fundamental theorem of mathematics developed by Kurt Gödel, the logical consistency of any given mathematical system or model can only be proven from within that system or model, but then the proof would be dependent upon the same initial theorems and postulates as the model itself. So any proof developed within the system or model as a whole is only a relative proof and then relative to any incorrect or unsubstantiated theorems that the system is based upon. Therefore, such a proof could never establish the absolute philosophical truth or the physical reality of the system. The absolute proof of any mathematical system or

model could only come from outside of that system or model. So only nature can prove any mathematical model or physical theory developed to describe nature, because nature is ultimately outside of that model or theory, no matter how sophisticated or advanced that theory becomes.

Some scientists and scholars have used a similar argument to demonstrate the impossibility of ever finding a TOE or final theory. When applied to physical theories in general, Gödel's theorem indicates that there will always be something outside of any and every mathematical model of nature that cannot be included in that mathematical model, and that thing is nature. So mathematics could never actually 'be' the reality as Tegmark argues. The simple fact that the superstring/brane theorists can derive a logically consistent model, at least within itself, based on their initial physical assumptions and mathematical postulates, in itself, does them no good at all because their models represent a philosophy rather than a physics. They are just using mathematics to turn the universe inside out, which alone solves nothing in either real physics or the real world. The proponents of the superstring theory must somehow relate their mathematical model to our common outside reality since there is no evidence or physical reason to accept the reality of hyper-dimensional strings. 'Strings' are only 'things' invented in and by the human mind. The mere fact that the mathematics of superstring theory is so complicated should be regarded as a clue that researchers are headed up the wrong path. Nature is simple, so a correct theory of nature should also be simple. The complicated mathematics that is associated with the superstring models results from our lack of understanding the fundamental principles of nature and nothing else. The mathematics would be easy if the scientists knew what they were doing.

The real question that needs to be answered in science is how has something so 'unscientific' and so highly speculative as superstring theory come so close to a becoming the new standard for a model of physical reality? The fact and existence of this situation represents at the very least an unnecessary and unwarranted weakening of the scientific method within the scientific community. Perhaps the strength of positivistic philosophies within science over the past century has led scientists to an over dependence on pure logic, which seems to have enhanced the position and importance of logical/philosophical pursuits over observations. In many scientific pursuits, human observation now forms the lowest possible level of evidence that can be offered for support of a theory or hypothesis. Human observation of some forms of phenomena is considered suspect in many cases if not questioned as real. Simply put, logical systems have come to outweigh observations in the new science that seems to be presently evolving. If pure logic is to assume a role in science superior to observation, especially to the point where observation is automatically cast into doubt when it seems to be at odds with 'a priori' philosophical points of view, then science is in trouble because logic is a product of and comes from the same human minds that have been conditioned by humans' experiences and observations of the world around them. In other words, logic is based upon previous observations, so the priority of logic over observation would actually represent both a logical paradox and an unnecessary step backwards for science. It would represent a return to some form of scholasticism even though scholasticism was thought to have been eradicated from science during the Scientific Revolution.

The scientific community is also plagued with far more than a simple smattering of frustration over its failure to develop a theory of unification in physics. All of the evidence at present shows that both the quantum and relativity theories are equally accurate in their own domains, but they are also mutually incompatible, which has made the unification of the two problematical at best. Under these circumstances, a growing sense that science is 'spinning its wheels' rather than progressing toward unification has emerged in the scientific community even while new problems such as Dark Matter and Dark Energy are emerging and forcing the issue of unification to the forefront of science. Many scientists openly admit the existence of severe problems in physics in general and with the leading theories of modern physics in particular. This situation fosters bad science and promotes an attitude within the scientific community of 'groping at any logical idea' that might be considered plausible (such as superstrings and branes).

The scientific community seems to be grasping at straws and the superstring theories have snuck into the scientific consciousness to fill a perceived theoretical void. Under these conditions, far too many scientists seem far too willing to relax normal scientific standards and try any hypothesis no matter how ridiculous, including the possible ultimate destruction of science's own standards for verification (as in the case of superstrings and branes). All of this just to advance science and allow it to progress past an extremely fundamental and important problem that science does not yet recognize or understand. These symptoms are all characteristic of an impending scientific revolution, but the theories that have been proposed (such as superstrings and branes) do not directly address the central issue that will define that revolution. The central issue is the simple question 'what is matter?' and this question needs to be answered before science, especially physics, can progress to its next level.

Kaluza and Klein

No testable predictions have come from the superstring or brane theories and their version of the Kaluza-Klein theory represents no more than an internally consistent mathematical philosophy, if that. So the only claim that the superstring/brane theorists could possibly make to support their contention that their models represent reality is their connection to past science. These theories depend very heavily upon their backward compatibility with real theories and normal science because that backward compatibility is their only connection to physical reality unless verifiable predictions can be made. In this regard, the superstring/brane proponents claim that their theories and models are advancements built on older theories: They claim the Kaluza-Klein theory as their basic physical starting point. This claim allows them to trace their ancestry to Einstein's general theory of relativity and thus justify and legitimize their theoretical work in the absence of other reasons to support their work. By taking this line of reasoning, whether they specifically state so or not, they have forced themselves to demonstrate that they have both progressed from normal science and are still making regular progress in science so that they can substantiate the claim that they are moving toward a new theory (M-theory) that will 'eventually' be verified. If they are not moving forward then they are standing, or worse moving backwards, and that is unacceptable in their situation. Failing this, they would have no proper physical theory, only an overrated hypothesis getting fat on imaginary growth hormones.

In other words, the superstring theorists claim they are building upon a successful unification of general relativity and electromagnetic theory (Kaluza's theory) and a modification of that theory that sought to further unify general relativity with the quantum theory (Klein's modification). For all practical purposes, there is no Kaluza-Klein theory, there is just Kaluza's theory and Klein's modification of Kaluza's theory, but proponents of the superstring theories need Kaluza-Klein to have the status of a legitimate theory to render their work relevant. In fact, these scientists often act as if there is only one theory, Kaluza-Klein, even though the only theory is Kaluza's original theory of 1921. Modern scientists are borrowing Kaluza's limited successes and wrongfully applying them to Klein's model. They seem to draw more support for their own theories from Klein rather than Kaluza's work, so they need for Klein's work to at least have been as successful as Kaluza's original theory, but it is not. These scientists did not 'rediscover' a Kaluza-Klein theory as they claim. They heard of Klein's work from other sources and elevated it from a simple hypothesis to the status of a real physical theory to support their own contentions.

Kaluza and Klein never worked together, nor did they ever publish a research paper together, and very probably they never even met each other. Many of the claims regarding aspects of the original theory that the superstring/brane scientists attribute to Klein were actually the product of Kaluza's mind, which is both strange and suspect for several reasons. But only one reason need be stated: Kaluza's theory was successful in what it attempted, but Klein's modification was completely unsuccessful and only Klein ever seems to have tried to develop his idea. On the other hand, Klein and others, including Einstein, further developed Kaluza's theory precisely because it had a limited success and thus offered a legitimate theoretical platform upon which further unification could proceed. Klein's modification offers only one of many attempts to further develop Kaluza's theory and in this sense it does not offer anything near a definitive interpretation of Kaluza's original model that would render all other changes unnecessary.

While it is fortunate for the superstring/brane people that Kaluza's theory was successful because it allows them to draw a direct historical link between their work and general relativity, Klein's quantum modification of Kaluza's five-dimensional field model (on which their case for the existence of strings relies more heavily) was a failure. The superstring and brane theories clearly utilize the successes of the previous theories, but ignore the fact that Klein abandoned his theory because it was unsuccessful. So the superstring and thus the brane theories are based upon an unsuccessful theory, at least so long as they claim the non-existent Kaluza-Klein 'theory' as the basis for their theoretical research. They would be better served to claim Kaluza's theory directly as their predecessor, but there are clear logical reasons why this cannot be done and logical reasons should carry some weight in a theory that is itself purely philosophical.

Theodore Kaluza sought to unify Einstein's new theory of general relativity and Maxwell's earlier electromagnetic theory in a single field structure based on a five-dimensional space-time continuum. However, Kaluza gave no physical reality to his five-dimensional hypothesis. He thought the fifth dimension no more than a mathematical device that he could use to derive the correct field equations and that is just what he did. But that it is all that he did. At

least that is all that can be concluded from his original paper, which is the only paper that he ever published on the subject. Kaluza's mathematical model was so restrictive that it left no room for predictions and was therefore not falsifiable. He merely duplicated Einstein and Maxwell's equations. So his theory was not taken as seriously as it should have been taken at the time. Even Einstein's general theory of relativity was not taken that seriously because it had no practical applications until the 1960s and 1970s. Had it not been for Edwin's Hubble's observations of an expanding universe in 1929, general relativity would probably have been considered nothing but an esoteric, even though correct, curiosity in physics until the space programs began in earnest in the 1960s. The third and final prediction made by Einstein when he originally developed the general theory of relativity was not even verified until 1960 when the Pound-Rebka experiment was conducted at Harvard.

In order to complete his unification, Kaluza placed very strict conditions on his mathematical model. Kaluza reasoned that each mathematical point in the space-time continuum was extended in a fifth direction forming an A-line perpendicular to our common four-dimensional space-time. He then placed two mathematical conditions on the A-lines: (1) each line was closed with respect to the higher dimension, such that each A-line or extended four-dimensional point formed a closed loop in the higher dimension, beginning and ending at the same point in four-dimensional space-time. (2) The lengths of all A-lines in the higher dimension, representing all points in normal space-time, were equal. However, there was s third condition that Kaluza assumed without actually stating, and that is the condition of continuity. Continuity is a fundamental aspect of the two field theories that Kaluza unified, so the concept must continue as a condition for the single five-dimensional field that he described. Each A-line was to be continuous within itself as well as continuous and unbroken with the four-dimensional space-time continuum. To further complicate the situation, although it seemed to have no mathematical significance, Kaluza suggested that the A-lines were extremely short because the higher dimension had never been sensed or detected. Given these restrictions, any later theory that is based upon Kaluza's model must keep all of his conditions intact. If a later theory based on Kaluza's model were to break or violate any of these conditions, with the exception of smallness, which was only suggested, it would be required to prove that its violation does not disrupt the unification between gravity and electromagnetism that Kaluza established.

Several years later, Oskar Klein noticed the periodicity in the higher dimension that Kaluza associated with each point in the space-time continuum as well as the smallness suggested by Kaluza, which allowed him to associate the length of the A-lines with the quantum of classical quantum theory. Klein's model came two full decades before the development of quantum field theory and had nothing to do with quantum field theory, which forms the basis of modern quantum theory. Klein attended the 1927 Solvay conference, seeking to press for recognition of his ideas, but was instead convinced by the quantum theorists that their views (the probabilistic interpretation of the wave function) were correct and he abandoned his five-dimensional quantum hypothesis. However, he did return to his earlier hypotheses and attempted to make changes in his initial model in 1939 and 1947, but still failed to render his hypothesis workable. So Klein abandoned the idea of explaining the quantum using the five-dimensional Kaluza model for good. Yet this is what the superstring/brane theorists base their own models of

reality upon: A faulty hypothesis that was abandoned as unworkable by its own creator. The superstring theorists have elevated Kaluza-Klein from an unworkable hypothesis to the status of a full-fledged theory for no other reason than to glorify and justify their own theoretical work.

In the late 1970s, string theorists were in a quandary how to proceed with their own hypothesis of substituting strings for points in the quantum theory, when the supergravity researchers discovered, adopted and adapted the Kaluza-Klein theory for their own purposes. Until this occurred, there was no Kaluza-Klein theory by any stretch of how a theory is defined in science. The supergravity people were attempting to unify gravity with the standard model of quantum theory by utilizing an eleven-dimensional Kaluza-Klein space-time model. The supergravity theories failed, but the string theorists found that Kaluza's (not Klein's) A-lines were ideal candidates to represent their 'strings' and a marriage of convenience, concept and ideas ensued. However, they expanded the new superstring model to ten or more dimensions, in order for the model to be plausible and workable.

No one seems to have ever commented on or investigated how increasing the number of dimensions beyond five would affect Kaluza's original unification of gravity and electromagnetism, they have just assumed that the unification remains intact and unchanged with the addition of still higher dimensions. However, the practice of 'assumption' in this case is just bad mathematics! 'Assumption' is not a valid mathematical or even logical tool. For people who claim a superior mathematical model of physical reality, the superstring/brane theorists seem not to have conducted the simplest of mathematical procedures to back up or justify their own claims. However, the superstring and brane theories are not without other logical problems that are far more significant.

The string theorists gave new physical meaning to Kaluza's A-lines by making them physically real structures and then related the lengths of the strings to the periodicity in quantum theory, just as Klein had done. However, they likened vibrations in these strings, or rather vibrational modes of the strings, to the actual physical properties of matter and the fields that we detect at each and every point in the four-dimensional space-time continuum. In the standard ten-dimensional superstring model, the strings are one-dimensional with each dimension above the normal four compactified and wrapped up in a small Calabi-Yau manifold. However, the analogy with vibrational modes that this model utilizes is untenable under these circumstances. Any real one-dimensional vibrating string vibrates in the next higher dimension. A one-dimensional string vibrates in at least a two-dimensional space. But all of the higher dimensions in the standard superstring model are tied up in the Calabi-Yau manifold and are thus unavailable to account for the vibrations of strings in the next lower dimensions. So where are these mysterious vibrations taking place? In what space or space-time are the strings vibrating? And then, what are these strings made of, such that they are even able to vibrate? Otherwise, how could something that is non-substantial vibrate? Are the strings made of some new kind of matter that only exists at such small dimensions and only exists to vibrate? If so, then a myriad of new questions should be raised about what this new matter is and where it came from. Quite clearly, the physical existence of strings introduces far more questions then it answers and the analogy of superstrings to real material strings is faulty at best.

Perhaps the vibrations are internal or intrinsic along the one-dimensional extension of the strings. The vibrations could actually be a pulse going round and round the little string loop, similar to the two wave speeds traveling through a real material string in opposite directions that interfere constructively to give the various vibrational modes and harmonies of a normal string. That pulse could possibly represent some form of density variations in the string, but the superstrings do not have the property of density. Superstrings do not even have properties other than their ability to vibrate. Density is normally a property of material substances. These theoreticians seem to have totally forgotten the basic physics of a real vibrating strings: The vibrations result from other physical phenomena, they are not fundamental properties of real strings. Yet the vibrations of the superstrings are used to determine the properties of space and matter that we detect in the microscopic and macroscopic portions of our world. Otherwise, that pulse could represent a stretching and contracting of the strings, allowing the strings to retain non-varying density along their one-dimensional extension. But then the changing length of the strings would violate Kaluza's second condition and destroy the unification of fields afforded by Kaluza's model. Even given the concept of a one-dimensional string having density, let alone density variations, the whole notion of vibrating strings is quite difficult to accept or understand under any of these circumstances. These logical points raise several questions, the least of which would be 'what then is a vibration when referring to a superstring' and 'how does that vibration affect the unification in the original Kaluza model upon which the whole thing is based?' Normal physics has been turned upside-down on its head by the superstring theories.

Furthermore, there is not even a hint as to what has happened to the curvature of the space-time continuum that forms the basis of general relativity? In the standard and more common interpretation of general relativity, curvature is considered an intrinsic property of the space-time continuum, which only requires a four-dimensional space-time structure. In other words, the density of space itself increases as a function of the energy-stress tensor: The amount and density of material at each point or position in space determines the density of space at that and surrounding positions. In this case, points in three-dimensional space and thus the A-lines in the fifth dimension would be packed more densely at positions inhabited by matter, where the energy-stress tensor would be maximized. Otherwise, the space-time continuum could really be five dimensional. In this case, the curvature of the space-time continuum would be considered an extrinsic characteristic of the continuum, *i.e.*, the curvature would be real in the higher embedding dimension or manifold. The five-dimensional interpretation of general relativity is completely compatible with but also completely independent of the five dimensionality utilized by Kaluza. So the two different notions of a fifth dimension complement each other to form a more complete theoretical structure.

However, if the different superstrings and only these superstrings occupy the fifth dimension as well as the higher dimensions, then the notion of a real curvature in a higher-dimensional embedding space would not be possible. How could one string in a lower dimension be curved within another string in the next higher dimension? Yet the concept of a higher embedding dimension is possible according to general relativity without any previous reference to Kaluza's model. From the purely relativistic perspective, the only logical reason for adopting a

higher embedding dimension would be to account for the extrinsic curvature of the four-dimensional space-time continuum in a realistic manner. Kaluza's theory is completely compatible with this interpretation of general relativity even though the two different notions of five dimensionality are separate and independent of one another. However, the notion of a higher embedding dimension and real curvature in that higher dimension seems at odds with the superstring theories which restrict the higher dimensions to the Planck length and then wraps them up in a Calabi-Yau manifold. What has happened to the curvature of space-time in the superstring model? Has the concept of curvature been replaced by the superstrings? If so, how does that fact square with both general relativity and Kaluza's original five-dimensional model? In other words, what exactly is the formal relationship between the superstrings and Einstein's metric, which characterizes normal four-dimensional space-time? A formal, *i.e.,* mathematical, relationship must exist because the superstring theories are ultimately based upon general relativity and Kaluza's theory is in fact an attempt to further generalize Einstein's theory by unifying it with Maxwell's electromagnetic theory.

If the superstring theory is to have any correspondence with the commonly accepted theories, principles and natural laws by which science presently describes reality, then it must clarify these issues and demonstrate that it is an advancement starting from these accepted paradigms. At the very least, the superstring theorists must revisit the issue of backward compatibility that they have so far taken for granted. Without this, superstring theory will have severed all of its ties to the very same theories on which is lays its only claim to be considered a valid scientific theory. Without verification or even the possibility of verification (falsifiability) and the lack of any evidence without even any implication for the existence of hyper-dimensional strings, superstring theory has nothing else but its backward compatibility with Kaluza and thus Einstein to lend it any semblance of a scientific possibility. If these connections are severed, then superstring theory is irrelevant to accepted science and superstring theory is just science fiction. Yet the concept and development of superstrings still has other problems, many of which have been voiced by other scientists and are well understood. In fact, some of these other problems have led to the morphing of superstring theory into the concept of branes.

Braneworld Physics

Some critics have claimed that there could exist as many as a million different versions of the string theories, if not an infinite number of independent string models. This particular argument parallels criticisms leveled against the possibility of a fourth spatial dimension during the late nineteenth century. At that time, detractors of the hypothesis argued that if a fourth dimension of space was real then there would be no reason to believe that only four dimensions of space existed. There could be five, six or more dimensions, or even an infinite number of dimensions. These arguments were rendered irrelevant by Einstein's development of special relativity, which recognized time as the fourth dimension. Similar arguments have been used against the superstring theories, although the superstring theories seem to have weathered that storm. Instead, the number of possible superstring models has been limited to five in which space-time is ten dimensional and an extra Bosonic string model which utilizes a twenty-six-dimensional structure. Of these, only the ten-dimensional models need be considered. However,

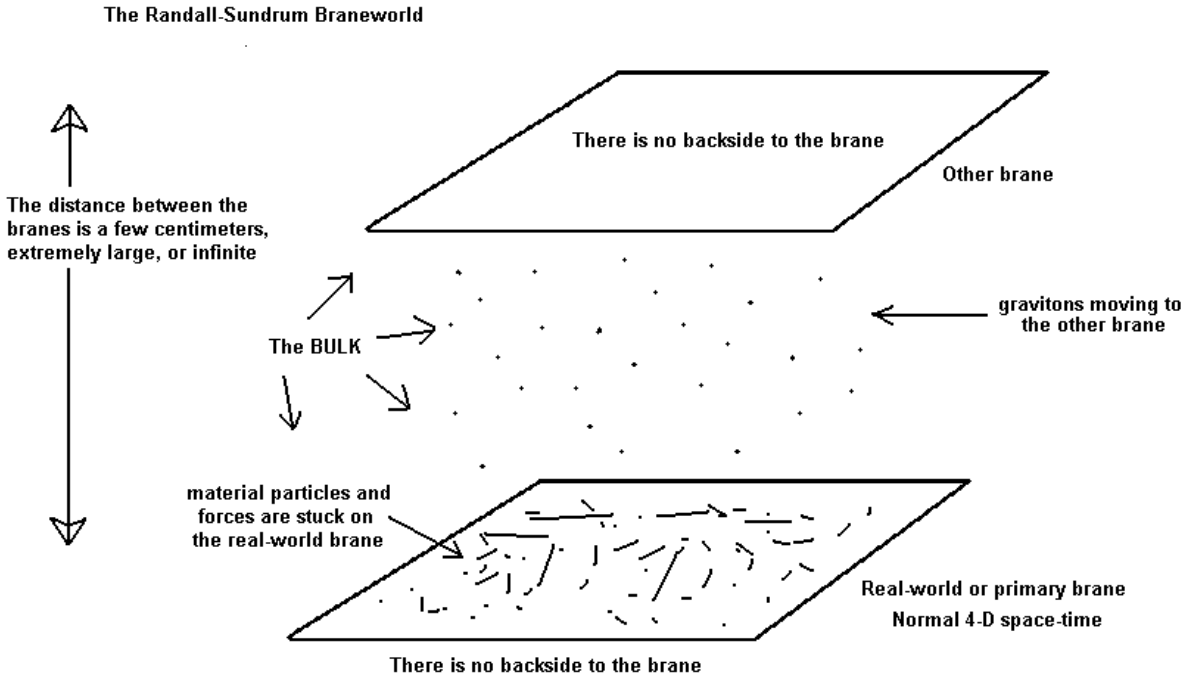
new developments in science or mathematics could later lead to additional self-consistent models. There is no rule or law that limits the possibilities to only those discovered thus far. All that is needed to develop more models is a small change in the basic assumptions and theorems upon which the present models are based.

So, there only seems to be five independent ten-dimensional models that are mathematically self consistent, or at least those are the only self consistent models that have yet been discovered: The Type I, Type IIA, Type IIB, E8×E9 heterotic and SO(3) heterotic strings. Why there are only five self-consistent models and no more is irrelevant at this time. However, we would hope that any new theory that expects to unify physics would have only one definitive structure, not five or six. This matter seems to have been partially settled in the 1990s when Edward Witten developed the concept of branes (membranes) of two or more dimensions. Suppose that we have a two-dimensional string instead of a one-dimensional string. This could be pictured as a two-dimensional (membrane) brane curled up into a tube. The extended tube replaces the string extending from each and every point in the four-dimensional space-time continuum. Using this and similar brane analogies, Witten and others have been able to derive definite mathematical relationships between the five different superstring models as well as the forerunner to superstring theories, supergravity. Witten's invention of branes re-invigorated research with superstring theories, which seemed more pathological than progressive by the 1990s. So now brane theories have become the rage in theoretical physics and the superstring community of scientists as the next step toward the mystical M-theory.

One brane theory in particular has gained quite a large following of adherents if not a lot of publicity and has proved quite popular outside of the scientific community: It is called the Randall-Sundrum Braneworld after its developers, Lisa Randall and Raman Sundrum. This model was developed to demonstrate why gravity is so weak relative to the other fundamental forces (interactions), yet so important as to bind all of the stars and galaxies in the universe together. This Braneworld model posits two four-dimensional branes suspended within a five-dimensional bulk. The bulk seems to have no other purpose than the convenience it affords the model by accounting for the distance between the two branes. The bulk seems to be no more than a mathemtical device that was only mandated to justify the distance between the two branes. The branes themselves have no other features than the fact that they are platforms upon which to place material reality, at least in the case of the primary or real-world brane. Unlike a normal membrane in three-dimensional space, the branes seem to be one-sided and the single side of each brane is facing the other at a constant distance. In one version of the Randall-Sundrum (RS) Braneworld, dubbed RS-1, the branes are a few centimeters apart, while they are extremely distant but not quite infinitely far apart in RS-2. In another version, the RS-1 branes are a very large distance from one another and infinitely far apart in RS-2.

In either case, our material world is restricted to only one brane. All points in this primary brane are actually bundled Calabi-Yau higher-dimensional strings, which allow the Randall-Sundrum model to duplicate (or so it is assumed) the standard model of the quantum theory. All of the natural forces (interactions), including electromagnetism, the electroweak and strong nuclear forces (interactions), are restricted to act within or across the primary brane according to

the standard model of quantum theory, except for the gravitons (gravity) that travel between the primary or real-world brane and the other brane. The large (non-Planckian) distance between the two branes accounts for the weakness of gravitational attraction relative to the other natural forces (interactions).



In spite of its beauty (such a beauty as only a mother could love), simplicity (only with a long stretch in the meaning of the term) and popularity (and it certainly is far too popular), this model is irrelevant to physics and the natural world of our experience. The various forms of the Randall-Sundrum model are 'scientifically' untenable even if they eventually turn out to be mathematically viable. But they are not even mathematically viable at present and mathematical beauty is an illogical personal opinion that is irrelevant in science.

It is bad enough that all of the problems stated above for superstrings in general carry over into all of the brane models, but this particular model breaks nearly every rule in the book of nature, at least so far as acceptable science is concerned. The bulk is totally undefined except for its dimensionality. The branes are also undefined and are not even analogous to real material membranes because they are one-sided and have no thickness in the fifth dimension that characterizes the bulk. Nothing is said about the extent or shape of the branes in the space-time that they occupy. It would seem that they must be parallel and thus Euclidean flat, which would imply that they are infinitely extended in the normal four-dimensions of space-time. Nothing is said about what exists on the backside of the branes, even though it seems that they should have

a backside. The branes are not continuous with each other or the bulk in general, in that the two branes and bulk are three distinct individual and separate 'things'. Under these conditions, this model breaks or completely obliterates Kaluza's first mathematical condition that our four-dimensional space-time be closed with respect to the higher dimension as well as his assumed condition of continuity. For some reason, picturing the Randall-Sundrum Braneworld models evokes visions of the old song "Me and My Shadow", but little else in the realm of physics.

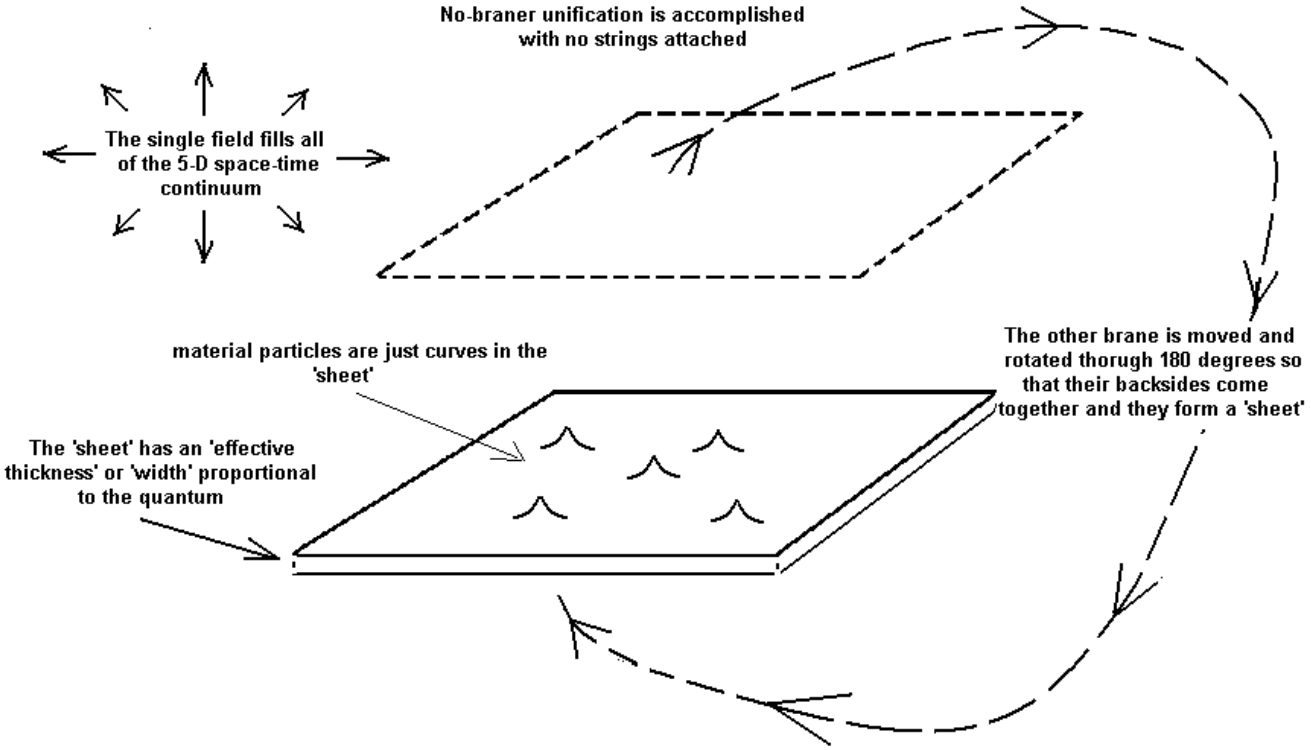
The superstring and thus brane theories are supposed to be dependent upon Kaluza's theory and thus general relativity; at least theoreticians assume so. But there is no space-time curvature associated with either of the Randall-Sundrum branes. In fact, gravitons shoot between the branes, but there are no gravitons in general relativity. At present, gravitons are no more than wishful thinking by those quantum theorists who hope to someday develop a theory of quantum gravity. At least no gravitons have ever been detected despite four or more decades of attempts to verify their existence. It also seems strange that gravitons are usually considered the exchange particles that travel between gravitationally attracted bodies in quantum gravity theories. However, in the case of the Randall-Sundrum Braneworld, gravitons do not travel between material bodies, which are stuck to the primary brane, but between the two branes. So how can gravitons account for the mutual attractions of material bodies in the primary brane if they are traveling between the different branes? So it would seem that the ever so popular Randall-Sundrum Braneworld model is little more than science fiction, and not even good science fiction at that. In spite of what some scientists have claimed, two branes are not better than one.

In fact, the basic Randall-Sundrum model is not even original. The American astronomer, Simon Newcomb, developed nearly the same model in the late nineteenth century. For Newcomb, the central problem was explaining the null results of the Michelson-Morley experiments and other attempts to detect the aether that was thought necessary to carry electromagnetic waves through empty space. He envisioned a truly physical model based on two parallel three-dimensional sheets, curved in a higher fourth dimension. These sheets were a short distance apart within the higher fourth spatial dimension and separated by the luminiferous aether of early electromagnetic theory. And his model did not work either.

No braner unification

However, all hope is not lost because the Randall-Sundrum Braneworld model has unwittingly and accidentally taken the next step toward the correct solution to unification. It would seem that trying to artificially align the superstring and brane theories with what science knows about nature has finally rendered them into a more realistic model, bringing them full circle back toward a natural model of reality: A natural model is one that works 'and' accurately describes the real world. But the superstring and brane theories do neither at present. In other words, the Randall-Sundrum model can be corrected by bringing it back into accordance with its origins in Einstein and Kaluza's original theories. It needs to once again be made backward compatible with Kaluza and Einstein, thus solving the major problems suffered by all of the superstring and brane models. The first step is to put a little spin on the model with an added twist. Since the backsides of the two Randall-Sundrum branes are undefined and the branes quite

far apart, the other brane can be rotated by one hundred and eighty degrees as it is moved until it comes into contact with the primary real-world brane that contains matter and the fundamental fields, backside to backside.



The two branes would then form just one two-sided ‘sheet’. This manipulation restores the model into compliance with Kaluza’s first condition that four-dimensional space-time continuum remains closed with respect to the higher fifth dimension.

Once four-dimensional space-time is closed in the fifth dimension, the Randall-Sundrum model still disagrees with Kaluza’s suggestion that the A-lines are extremely small in length. But Albert Einstein and Peter Bergmann showed that the A-lines could be macroscopically extended in the higher dimension without affecting the unification of general relativity and electromagnetism in 1938. Einstein, Bergmann and Valentine Bargmann then repeated their mathematical demonstration of that fact again in 1941. So there are no Planckian strings attached to the four-dimensional ‘sheet’ and the A-lines can be as long as necessary. Next, it is necessary to restore continuity to the model, an act that just happens to define the bulk. The bulk is no more nor no less than the single continuous field that Einstein sought to identify and characterize in his decades long search for a unified field theory. This single field is the precursor to the gravitational, electromagnetic and other physical fields that define our material universe of experience, as well as matter itself. There are no gravitons, a simple fact which will save all

those many scientists who have been trying so hard to detect them for the last four or more decades and failed so miserably from further embarrassment and failures. The notion of a four-dimensional one-sided brane disappears and is replaced by a 'sheet', or at least that is what Bergmann and many others called it. The British mathematician J.J. Sylvester also described this structure as a 'film' in 1869 in his presidential speech before the British Association for the Advancement of Science. He was introducing and explaining the four-dimensional theoretical model of space proposed by W.K. Clifford.

The 'sheet' is completely continuous with the five-dimensional single field (the bulk) because it is merely the densest portion of that field. So the physical existence of strings of any kind is unnecessary, although the concept of A-lines still offers a convenient method for developing a mathematical model of the single field. The 'sheet' has no true width because it is not a separate 'thing' from the single field. However, it does have an 'effective width' or 'thickness' in the fifth direction that is proportional to the quantum or rather the fine structure constant. So the continuity of the gravity and electromagnetic fields is preserved while the quantum is defined relative to the four-dimensional space-time continuum. Since the 'effective width' of the 'sheet' in the fifth direction defines the quantum, there is no need to adhere so strictly to the standard model of quantum theory as do Randall, Sundrum and all of the other superstring and brane theorists. This means that the individual mathematical points in the real four-dimensional space-time continuum do not need to be represented by little balls of string tied up in knots described as Calabi-Yau manifolds.

In other words, only five dimensions and a few physical constants are necessary to accurately describe and model all of physical reality. By getting rid of most of the higher dimensions needed by the superstring models, a great deal of the overly complicated mathematics used to describe and justify the superstring models is no longer necessary, rendering a mathematically simpler theory and model of reality. The points in real space-time are just that, points, described in the higher dimension as imaginary A-lines (not vibrating strings), just as Kaluza described them. The A-lines are merely a mathematical device to describe the continuity of the single field in the higher embedding dimension. The A-lines could simply be regarded in a manner similar to Faraday's 'lines of force' in the three-dimensional space of classical electromagnetic theory.

And finally, the extra higher dimensions and the Calabi-Yau bundles and manifolds are completely unnecessary since all of the properties of matter and space are explained by Maxwell's theory of electromagnetism and Einstein's general theory of relativity, which posits a four-dimensional space-time continuum that is extrinsically curved in the fifth embedding dimension. Kaluza's theory then ties these two common fields together in a unified field theory that can also account for the other natural fields. This model identifies and completely explains the true nature of matter, or rather what we detect and interpret as matter, as well as all of quantum theory and the four natural forces (interactions) that govern our universe. This single field model also explains Dark Matter and Dark Energy and completely unifies physics in a way that no other theory can even come close to accomplishing.

Although this theory was derived by way of the superstring and brane theories in this instance, it was originally developed nearly three decades ago as an extension of the efforts of Einstein and his colleagues seven decades ago to make Kaluza's model work. As always, nature rules and humans follow her lead along the path laid before them, so the sordid ways of the superstring and brane theorists have just led them away from reality (into a lost world of ten or more dimensions) along a circle that finally returned them to nearly the correct position (place or point) that had been there from the beginning. It is even informative to paraphrase and adapt an old saying to describe the relationship between these different models of physical reality: A 'sheet' in hand is worth two branes in the bulk.

Conclusion:
Give them enough string and they will hang themselves

The ever-popular superstring and brane models of physical reality are physically impossible. They represent no more than a class of purely mathematical and philosophical attempts to describe our physical universe. These theories need to pass at least one test to even be classified as physical theories rather than mathematical speculations. In order to do so, the superstring/brane theories must be able to answer one of the following conditions positively:

(1) They must be falsifiable, or
(2) They must make predictions that are or will be verified, or
(3) They must be based upon real physical entities that are observable and/or measurable, or
(4) They must be backwards compatible with accepted theories if not demonstrate that they are advances stemming from accepted science.

However, the superstring and brane models fail all of these conditions. They cannot answer any of these conditions in the positive. These theories are simply based upon no more than a hope and a prayer that maybe someday they might perhaps be able to answer yes to the second condition.

The superstring and brane models presently fail (1) and (2) because they are purely mathematical with no real connections to the natural world. As yet, after three decades of efforts, they have made no predictions that are testable, nor have they provided any evidence that they are even capable of being tested so they are clearly not falsifiable. Both of these instances are commonly known and commented on by other scientists. Yet these theories also fail (3) because strings, superstrings and branes are not measurable, detectable or observable. All three of these supposedly physical entities were invented by analogy to real physical objects even though there is nothing in physical reality to either imply or confirm their existence. They are imaginary products of the human mind. However, when compared to their real physical counterparts, the analogies fall apart. Superstrings could not possibly vibrate in any manner that is physically possible and branes lack any physical properties whatsoever except for their purported existence. Branes are just mathematical inventions that were developed to make the mathematics of the superstring theories work.

These theories and models also fail the last condition (4) because they are not backward compatible with the very theories upon which they are supposedly based: Kaluza and Einstein's field theories. Various aspects of the superstring and brane models actually contradict or violate the mathematical conditions that Kaluza based his unification upon. They either violate the fact that the strings must loop back to the four-dimensional space-time from which they originated, or they must be of equal lengths as well as unbroken and thus continuous. The same is true for various brane models. Neither of these groups of theories and models explains how they can cope or deal with the concept of space-time curvature in general relativity, nor whether they are replacing or supplementing curvature and how doing so would affect their basic models, even though they are ultimately extensions of general relativity. Since these theories do not fulfill any of the stated conditions, they cannot be considered physical theories. They have no connection to our physical world other than the fact that they were developed in the imaginations of humans with real material brains.

However, correcting the most popular of the brane models, the Randall-Sundrum Braneworld model, is easy. This correction can be accomplished by altering the model in such a way that adherence to Kaluza's conditions is guaranteed. Randall and Sundrum luckily hit upon the correct solution to unification when they adopted a five-dimensional approach to brane theory. Randall and Sundrum just applied that hypothesis incorrectly: Two branes are unnecessary where one 'sheet' will suffice and the bulk that they use is no more than the single unified field that Einstein sought to describe and characterize in the last three decades of his life. In other words, the progression from Einstein to Kaluza to Klein to strings to superstrings and finally to branes has just gone full circle and returned to a single field theory that had been previously developed by Einstein, his colleagues and others. This sequence of events only tends to confirm the fact that science proceeds from nature and not from the wild speculations and meanderings of the human mind, no matter how logical the road taken by the mind. Nature will always force science back to the road mapped out by its own natural truth. In the end, nature is simple, so the more philosophically or mathematically complicated the theory of model of nature that humans derive, the further the mind has traveled away from truthfully describing nature.

Bibliography

James E. Beichler. "Ether/Or: Hyperspace Models of the Ether in America". In *The Michelson Era in American Science: 1870-1930*. Edited by Stanley Goldberg and Roger H. Stuewer. AIP Conference Proceedings, 179. American Institute of Physics, 1987: 206-223.

Beichler, James E. *A five-dimensional continuum approach to a unified field theory*. Master's Thesis, San Francisco State University, December, 1980; Republished in *Yggdrasil: The Journal of Paraphysics* 2, 2 (Winter Solstice 1999). On the Internet at <members.aol.com/yggdras/paraphysics/5dchap1.htm>

Beichler, James E. "Up, Up and Away! The fifth dimension in physics". *Yggdrasil: The Journal of Paraphysics* 1, 2 (Summer 1997). On the Internet at <members.aol.com/mysphyt1/yggdrasil-2/kal1x.htm>

Beichler, James E. "Toes, Fingers and the Nose on Your Face". Chapter four, *The Paraphysical Principles of Natural Philosophy*. Doctoral Dissertation, Union Institute and University, June 1999; Republished in *Yggdrasil: The Journal of Paraphysics* 1, 4 (Winter Solstice 1998). On the Internet at <members.aol.com/yggdras/paraphysics/toe1.htm>

James E. Beichler. (2007) “Three Logical Proofs: The five-dimensional reality of space-time”. *Journal of Scientific Exploration*, (2007): .

James E. Beichler. “Twist ‘til we tear the house down”. Originally presented before the International Conference on General Relativity and Gravitation, Johnstown Campus of the University of Pittsburgh, June 1991; Later published in *Yggdrasil: The Journal of Paraphysics* 1, 1 (Winter Solstice 1996). On the Internet at <members.aol.com/Jebco1st/paraphysics/issue1.htm>; To be republished in *Space-Time, Ether and Cosmology*, Volume II. Edited by Michael Duff. Great Britain: 2008.

William Kingdon Clifford. "On the Space-Theory of Matter". Read 21 February 1870, *Transactions of the Cambridge Philosophical Society* 2 (1866/1876).

Albert Einstein and Peter Bergmann. "On a Generalization of Kaluza's Theory of Electricity". *Annals of Mathematics* 39, 3 (1938): 693-701.

Albert Einstein, Peter G. Bergmann and Valentine Bargmann. "On the Five-Dimensional Representation of Gravitation and Electricity". *Theodor von Karman Anniversary Volume*. Pasadena: California Institute of Technology, 1941: 212-225.

George Gamow. *One, Two, Three,Infinity*. Viking Press, 1947.

Paul Halpern. *The Great Beyond: Higher Dimensions, Parallel Universes and the Extraordinary Search for a Theory of Everything*. New Jersey: Wiley and Sons, 2004.

Theodor Kaluza. "Zur Unitätsproblem der Physik". *Sitzungsberichte der Preussischen Akademie der Wissenschaften* 54 (1921): 966-972.

Oskar Klein. "Quantentheorie und fünfdimensionale Relativitätstheorie". *Zeitschrift fur Physik* 37 (1926): 895-906.

Oskar Klein. "The Atomicity of Electricity as a Quantum Theory Law". *Nature* 118 (1926): 516.

Oskar Klein. "Zur fünfdimensionale Darstellung der Relativitätstheories". *Zeitschrift fur Physik* 46 (1927): 188-208.

Oskar Klein. “On the Theory of Charged Fields”. *New Theories in Physics*. Paris: International Institute of Intellectual Cooperation, 1939: 77-93.

Oskar Klein. “Meson Fields and Nuclear Interaction”. *Arkiv for Mathematik, Astronomi och Fysik* 34A (1947): 1-19.

Charles Misner, Kip Thorne and John A. Wheeler. *Gravitation*. San Francisco: Freeman, 1973: 417-428.

Simon Newcomb. “On the Fundamental Concepts of Physics”. Abstract in the *Bulletin of the Washington Philosophical Society* 11 (1888/1891): 514-515; A roughly typed copy of the complete talk can be found in Box #94, The Newcomb Papers, Library of Congress, Washington, D.C.

Thomas Kuhn. *The Structure of Scientific Revolutions*. Chicago: University of Chicago Press, 1962.

Lisa Randall and Raman Sundrum. “A Large Mass Hierarchy from a Small Extra Dimension”. *Physical Review Letters* 83 (1999): 3370-3373. Eprint at ArXiv: hep-ph/9905221.

Lisa Randall and Raman Sundrum. "An alternative to compactification". *Physical Review Letters* 83 (1999): 4690-4693. Eprint at ArXiv:hep-th/9906064.

Lisa Randall. "Extra Dimensions and Warped Geometries." *Science* 296 (2002): 1423-1424.

Randall, Lisa. *Warped Passages: Unraveling the Mysteries of the Universe's Hidden Dimensions*. New York: Harper Perennial, 2005.

Smolin, Lee. *The Trouble with Physics: The Rise of String Theory, the Fall of a Science, and What Comes Next*. Houghton Mifflin, 2006.

Sylvester, J.J. "Inaugural Address to the Mathematics Section." *Reports of the British Association (Exeter)* 39 (1869): 1-9; Reprinted as "A Plea for the Mathematician". *Nature* 1 (30 December 1869): 237-239; Reprinted in *Laws of Verse*. London: Longmans, 1870; And *Collected Papers*: 650-719.

Tegmark, Max. The Mathematical Universe. Eprint at ArXiv: hep-ph/07040646.

Tegmark, Max. "Mathematical Cosmos: Why numbers rule". *New Scientist* 195 (15 September 2007): 38-41.

Woit, Peter. *Not even Wrong: The Failure of String Theory and the Search for Unity in Physical Law*. New York: Basic Books, 2006.

Woit, Peter. "Not Even Wrong - The Blog." On the Internet at www.math.columbia.edu/~woit/wordpress

Yggdrasil Homepage

This article is copyrighted, but may be quoted, copied and circulated freely as long as the text is unchanged and the author given proper credit. No one may charge any type of fee for copies of this material or republish the article without the express approval of the *Yggdrasil's* editor and publisher.

Last Updated 22 December 2007

Send e-mails, comments and suggestions to Jim Beichler, editor, at

Jebco1st – at – aol.com