

Relativity, the surge and a Third Scientific Revolution

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Abstract: Quantum theory emerged the victor of the last Scientific Revolution even though relativity theory had a more progressive view of reality to offer science. As a result, the physical aspects and properties of the gravitational field were never fully explored or exploited and science went through several decades of denial concerning the relevance of general relativity and its physical implications. The only small victory that relativity theory could claim before the 1960s was in cosmology with the expanding universe. The victory was small because the expanding universe was far from the everyday needs of a science more concerned with the atom and the nucleus. Under these circumstances, the theory of relativity had no practical applications in the everyday real world, so its theoretical implications were largely ignored. However, the 1970s brought something of a resurgence of good fortunes and everyday relevance for relativity theory and quantum theorists finally accepted the possibility that unification was the primary goal of physics, albeit a unification based upon the quantum concept of discrete particles rather than the Einsteinian concept of field continuity: According to quantum field theory, the gravity field could be reduced to an exchange of gravitons. But what at first seemed a resurgence of general relativity under the quantum paradigm in the 1970s has slowly evolved into a surge of physical relevance resulting in the emergence of general relativity as a dominating field of research in physics. And the story does not end there. The recent discoveries of Dark Matter and Dark Energy are about to push physics and relativity theory into a Third Scientific Revolution in which a unification with the quantum will be made on relativity's terms. The quantum will not emerge out of the mathematics as a constraint on the continuous field as Einstein had hoped, but it will emerge as a field constant that limits the continuous field as described by general relativity.

Keywords: Second Scientific Revolution, Third Scientific Revolution, Mach, positivism, Mind, Matter, consciousness, motion of matter, crises, quantum, relativity, curvature, higher dimensions, Einstein, history, paradigm, Standard Model, cosmology, surge, Dark Matter, Dark Energy

Introduction

A scientific revolution occurred between the years 1900 and 1927. No one would dare disagree with this fact. But that revolution was never completed, a fact with which very few, if any, would agree, but a fact all the same. This Second Scientific Revolution was an unfinished symphony of science. In fact, this incompleteness led to a well-known series of philosophical debates after the 1920s, but they never resulted in any direct physical challenges to the quantum theory. Any problems that were foreseen with quantum theory were problems of interpretation

rather than problems of a physical nature. That fact has been the strength of the quantum philosophy as well as its major flaw. The very fact that the revolution started in 1900 when Max Planck published his seminal paper on blackbody radiation and ended in 1927 with the Solvay Conference settling the primary issues and questions regarding quantum mechanics readily demonstrates that the revolution has been completely dominated by the quantum theory. Yet two different crises seemed to have caused the revolution, the blackbody radiation paradox and the failure to detect the luminiferous aether, while only the blackbody problem led to quantum theory. The accepted solution to the aether problem came in the form of relativity theory.

The story of relativity theory and the important dates of 1905, 1912 and 1915 in the development of relativity seem to have been overwhelmed by the story of the quantum, as if they were not as important unless they were somehow related to the quantum story, even though relativity forms the second leg upon which the revolution stood. To further complicate this mess, Newtonian theory was at the height of its success at the outset of the revolution, which implies that a paradox of history exists, while relativity theory is generally grouped with Newtonian theory as a form of 'classical' physics, *i.e.*, old physics before the second revolution that is philosophically contaminated. These historical inequities need to be identified and understood before science can come to terms with the next scientific revolution because the seeds of the next revolution can be found in the failures and misconceptions that arose during the Second Scientific Revolution. To understand the past revolution more completely is to understand how science has evolved since the past revolution and where the future is taking science.

First of all, the standard view that scientific revolutions (Kuhnian view) result from crises does not offer all that accurate and complete a picture of the historical events. It does not take into account the fact that the crises themselves resulted from the successes of previous theories and the subsequent attempts to expand the previous paradigms. Those successes represent the constant ongoing evolution of science, which is just as important as the revolutions in science as well as intimately related to the emergence of revolutions. Newtonianism was completely progressive and it never failed, not even during the revolution that supposedly overthrew it. It had come so far that its successes forced science to consider phenomena and natural processes that were previously off-limits to science, *i.e.*, the ultimate nature of life, mind, consciousness and even matter itself. In fact, Newtonian physics had solved both of the crises before the revolution. Lorentz-Fitzgerald contraction had already been offered as the solution to the aether problem before it was derived by Albert Einstein in 1905 from first principles, without resorting to the hypothetical aether. That is why it is still called Lorentz-Fitzgerald contraction today, in spite of its more modern relativistic interpretation. Furthermore, Planck considered his solution to the blackbody problem a completely statistical and thermodynamical solution, well within the context of Newtonian science, rather than a revolutionary new solution. Quantum theory really began in 1905 with Einstein's solution to the photoelectric effect.

Secondly, the purely philosophical issues leading to the Second Scientific Revolution have been completely subverted, ignored and lost to history by the shift of emphasis to a philosophical rivalry between determinism (classical and Newtonian) and indeterminism (quantum mechanical), which in turn was heavily influenced by the positivism adopted by scientists during the revolution. From a far broader historical and philosophical perspective, the real (unknown and unsuspected) revolution resulted from a shift in the boundaries between the

realms of Mind (spirit) and Matter (the mechanical universe) that had originated with René Descartes during the Scientific Revolution of the seventeenth century before they were institutionalized by Isaac Newton in the *Principia*. Physics has always been about matter and the ‘motion of matter’, as it still is, but the fundamental nature of matter has never been discovered, nor has the fundamental nature of the mind that perceives and conceives matter. Yet these facts have gone completely unmentioned and unexplored by scientists, scholars and academics alike.

Given this broader philosophical perspective, relativity theory actually forms a more realistic basis for the revolution than the quantum because relativity sought to completely change the scientific concept of matter by equating matter to space-time curvature. But that change never occurred, at least not yet. Relativity theory also took a positivistic turn early in its history, succumbing to the strong positivistic influences that dominated science during the era. Under the growing influence of positivism, science interpreted space-time curvature as an intrinsic property of the four-dimensional space-time continuum instead of attaching any real physical meaning to the concept of curvature. General relativity was thus reduced to a secondary role in physics behind quantum physics. It became no more than a mathematical artifice and was given little or no physical meaning. Edwin Hubble’s observation of an expanding universe was the only real physical success of any note that relativity could claim before the 1960s and it had very little to do with the common everyday physical phenomena that scientists investigate. Relativity had no practical uses in science and the everyday world, so it was relegated to an esoteric existence within theoretical physics.

The end product of this story is that physics is still dominated by the quantum paradigm today and the physical interpretation of relativity theory is given very little credence, at least nowhere near the fundamental influence in science that it has earned or deserves. Quantum theory is still considered the most accurate theory ever produced by the human mind, even though general relativity passed the quantum theory in accuracy of prediction more than a decade ago. The accuracy of general relativity continues to increase with each passing day: A satellite is currently testing frame dragging near the earth as well as microgravity and new tests of general relativity in the upper and lower extremes of its applicable range are being conducted in cosmology. Yet quantum theory and its underlying assumption of the discrete nature of reality still seem to dominate physics and science.

So, where and how did science, especially physics, go astray? The answer is not that hard to find. The revolution actually went astray before it started in 1900, primarily through the philosophical work and later influence of Ernst Mach and especially his followers. However, this interpretation of history should not be construed as implying that Mach’s work was wrong, nor that it was bad or even unnecessary for the continuing progress of science. In all respects, Mach’s work was in strict keeping with his era, extremely important to the history of science, completely necessary for his time and quite necessary for the continued advance of physics. Unfortunately, science has held on to Machian positivism for too long to benefit the latest and newest advances in physics. Science has outlived the strict Machian positivism to which it has adhered for the past century and needs to move on before nature forces the issue.

‘Mach’ing modern physics

By the 1840s, Newtonian Natural Philosophy (physics) had become so successful that science achieved the status of a profession and Natural Philosophy split into the different branches of science that we know science by today. Within the next decade Newtonian successes continued with the development of thermodynamics and electromagnetic theory in physics and evolution within the sciences in general. Darwinian evolution was clearly a Newtonian mechanism. The Newtonian system of science was so successful that it began to consider problems that had been passed over in science's rapid rush forward as well as older problems that had been relegated to religion and metaphysics by Descartes' division of Mind and Matter. Science began to think seriously about the origin and nature of life, mind and consciousness as well as matter. In some cases, the scientific speculations on these subjects went too far and too fast, so a scientific backlash developed. Science had also matured enough to sit back on its laurels and take a good look at itself as well as openly criticize its excesses. Not only were the most extreme scientific speculations on physical matters an open sore for conservative science, but the educated public seemed to go their own way with the changing standards by establishing movements like Modern Spiritualism. Under these circumstances, criticism of science and critical analysis of its development and procedures began to emerge. Within this context, the work of Ernst Mach seemed to capture the conservatism of science better than the work of any other scholar. Mach was not the only scientist or scholar to question the scientific and philosophical excesses of the era, but he was fairly outspoken and emerged as the chief spokesperson for the backlash.

Mach's system of logical empiricism quickly evolved into a logical or empirical positivism that denied the possibility that humans could ever directly know or experience either mind or material reality. Newtonian science had long been the ideal of objectivity, but science could no longer dissociate the observer and the observed material reality. Newtonian objectivity had been corrupted by the excesses of scientific speculation. In other words, science discovered that mind was just as important in physics as matter, but this fact was hidden by the adoption of Mach's positivism. The distinction between the mind that perceives matter and interprets the matter that it perceives had become blurred at the same time as the 'crises' in physics emerged and new discoveries were made (x-rays, the electron and radioactivity) that stretched the limits of physics. The boundaries between Cartesian/Newtonian Mind and Matter began to shift all the more erratically.

Mach himself advocated a middle-of-the-road approach to the Mind/Matter dichotomy without even acknowledging its existence, let alone its importance. Instead, Mach concentrated on 'sensations'. He declared that science (and thinking humans) can never know either mind or matter directly, because we only know of them through our sensations of the outside world (the physical environment). Science was therefore reduced to discovering efficient and economical systems of Natural Laws that reflected our sensations of reality rather than reality itself. The positivistic school of philosophy adopted Mach's views, or perhaps it was the other way around, but what developed in the following decades was the philosophical denial that science could ever know, understand or reduce either mind or consciousness on the one hand and matter or material reality on the other hand. Mach's positivism implied that if mind and matter were beyond direct knowledge and experience, then it was nonsense to consider them as subjects for direct investigation in science.

Others in the scientific community reacted to the same successes of Newtonian science and recognized the need for a new science of mind in the late 1800s. The philosophical subject of psychology was no longer about the philosophy of mind alone and the new science of psychology began to emerge. The birth of psychology resulted from the work of several scientists reflecting the importance, relevance and widespread nature of the issue of mind to science at that time. Wilhelm Wundt developed experimental psychology, Sigmund Freud developed medical psychology or psychiatry, Gustav Fechner developed psychophysics and William James developed the philosophical and paranormal basis of the new science. The new science was supposed to be about mind and consciousness, but it took a positivistic turn and was developed as a science of behaviorism after the 1913 work of John Watson. Behaviorism is no more than Machian sensations applied to psychology, just as indeterminism is no more than Machian sensations and their limits applied to the quantum theory. Psychology lost consciousness and probably its mind in 1913, while the rest of science silently acquiesced and thus seemed to agree that it did not 'matter'.

The revolution in physics was actually about the 'motion of matter', not about matter itself. Both of the crises, blackbody radiation and luminiferous aether, addressed physical interactions between matter and electromagnetic waves, while the new discoveries of x-rays, radioactivity and the electron also pointed toward a new understanding of matter and how matter interacted with waves. So it would seem that the second revolution should have been about matter directly, just as the new science of mind should have dealt directly with mind, but that was not the case. Instead the revolution in physics after 1900 addressed only the 'motion of matter'. In fact, the revolution redefined the 'motion of matter' in three different extremes. Motion was redefined at extremely high speeds near the speed of light in 1905 by special relativity, near extremely large gravitating masses by general relativity in 1915 and at the sub-microscopic extremes (levels) of reality by Planck in 1900, Einstein in 1905, in orbits around atomic nuclei by Nils Bohr in 1913, as matter waves by Louis deBroglie in 1923, as probabilities by Werner Heisenberg in 1926 and finally as waves by Erwin Schrödinger in 1926.

While the motion of matter was redefined in the revolution, no definition of matter was ever attempted. The closest that scientists ever came to defining matter came in Einstein's general theory which equated matter to space-time curvature, but the positivistic philosophies rendered that curvature intrinsic to four-dimensional space-time and therefore just a mathematical gimmick rather than a physical existence. The whole question of the ultimate nature of matter was left sorely open. In fact, the issue was completely sidestepped by changing the philosophical basis of the revolution to a rivalry between the forces of determinism and indeterminism and rendered irrelevant to the continued progress of physics under the guise of the quantum. Quantum theory had won the revolution at the expense of relativity theory and a direct interpretation of matter, but it brought with it the baggage of the discrete nature of matter as opposed to the continuous nature of matter. Yet the seed of the coming revolution was sown in quantum's incomplete view of nature.

The unfinished revolution

In general, when human logic is applied to nature, it will eventually lead to a logical impasse because human logic does not perfectly duplicate the logic of nature. Furthermore, the

ability of advancing technology to measure nature at its extremes eventually surpasses the ability of human logic to explain nature with any one given theory, so discrepancies between human explanations and nature tend to grow as time passes. In other words, nature rules over and hopefully guides the theories and hypotheses of science or, rather, the theories and hypotheses of mankind do not rule over nor do they guide nature. Nor is there anything in nature that guarantees that any specific human made theory will last forever and quantum theory makes a good example for this principle. Quantum theory is a very logical system, but as science and technology measure (and observe) nature ever more carefully and accurately the human logic of quantum theory has digressed further from the true logic of nature. Quantum theory does not have the innate ability to decide if it is a complete system, nature decides if quantum theory best represents her. While quantum theory claims to be complete, it needs to invoke both consciousness and entanglement (neither of which it can explain) from outside of its logical framework to make the theory work. Quantum theory also needs to invent an ever increasing number of particles to support its discrete view of reality, a practice which is grossly *ad hoc* at best.

In the past few decades, the most advanced theory in the quantum catalogue of theories, the Standard Model, has been making mistake after mistake. Gravitons and super-symmetry particles have never been detected. Nor have magnetic monopoles or the purported decay of protons been detected. Neutrinos have been found to have mass even though the Standard Model predicted that neutrinos should be massless. And finally, the Standard Model could not do away with mass so it is now looking for the Higgs particle (or field) to explain mass. At what point do scientists throw up their hands and consider the possibility that the Standard Model is pathological and moribund?

The Standard Model will eventually fail because the positivistic quantum hypothesis upon which it is ultimately based masks the central problem of science and reality, the Cartesian/Newtonian distinction between Mind and Matter (which only exists now in the difference between subjective and objective) by convincing everyone that determinism and indeterminism are the central and most fundamental issue in science. Quantum theory refuses to consider the ultimate nature of matter as an issue, so it keeps inventing new particles to account for the fundamental physical properties of real material particles. Properties of material particles are not themselves particles. Yet quantum theory still considers itself complete and assumes that any future unification with general relativity (gravity theory), which most scientists have only admitted is a worthy goal for physics in the past three decades, will be based on the quantum hypothesis. Quantum theory thus renders itself progressive in its own eyes as opposed to relativity, which it classifies as classical, as if classical is old fashioned and bad. While the results and predictions of quantum theory are valid within a specific range of phenomena, it is incomplete and limited to that range of phenomena alone. Otherwise, science may have reached the limits of the quantum hypothesis and alternatives may have become necessary. Pushing the quantum theory forward under these circumstances is just creating new paradoxes such as the ever growing number of 'elementary' particles.

Although quantum theory is incomplete in its most fundamental assumptions and aspects, stating so still remains heretical, at the very least, against the overwhelming popularity of the quantum paradigm. The fact that quantum theory is incomplete has been suspected since the

development and takeover of quantum theory by quantum mechanics at the 1927 Solvay Conference. It is widely known that Einstein and Bohr debated this very issue and that Einstein 'lost' the debate, or that is how the story is told by the quantum historians who have written their own history. But other scientists also objected to the strict takeover of the quantum concept by quantum mechanics. Schrödinger never completely bought into the statistical (quantum mechanical) interpretation of his wave mechanics. Oskar Klein was talked out of his five-dimensional model of the quantum that was based upon Theodore Kaluza's unification of general relativity and electromagnetism. Louis deBroglie was also convinced that his theory of the 'double solution' was useless and he was converted to the quantum camp. Yet both Klein and deBroglie later returned to their original views and theories. Even Einstein later returned to criticize the quantum theory in what has become possibly the most misunderstood philosophical argument of all time, the 1935 EPR paper. And finally, Schrödinger developed his cat paradox and the concept of 'entanglement' in the 1930s to demonstrate how ridiculous quantum theory had become. But these were only seen as minor irritants and the Copenhagen Interpretation of the quantum prevailed.

The point is that these and other criticisms regarding the incomplete nature of the quantum theory were never really taken seriously because they did not take into account the real nature of that incompleteness: The failure to properly identify the root cause of the problem in the shifting boundaries between Mind and Matter. And this problem renders the Second Scientific Revolution incomplete, not just the quantum theory that emerged during the revolution. So the positivist takeover during of the second revolution doomed the revolution to only a partial completion, at best, and in so doing it also planted the seeds for the next revolution. The whole rise and takeover of the quantum concept by statistics and indeterminism, as institutionalized within the Copenhagen Interpretation, was pure positivism and thus incomplete by definition. Yet the effects of positivism went further and adversely influenced relativity, the alternative point-of-view. The possible physical reality of space-time curvature in a higher dimension implied a new fundamental way of conceptualizing the ultimate nature of matter, but Einstein and the relativists surrendered to positivism and reduced curvature to an 'intrinsic', purely mathematical (non-physical) property of the space-time continuum. Their surrender, coupled with the fact that relativity was totally impractical for nearly all scientific purposes for the next several decades, sealed the coffin for relativity as a competing theory to explain the most fundamental aspects of physical reality.

A higher-dimensional space would be necessary to the physical reality of space-time or spatial curvature, but higher-dimensional spaces had never been sensed, perceived or observed in any manner, so they could not possibly exist according to the positivist doctrine. However, higher-dimensional space-times have become popular in the last three decades as the only way out of the quantum impasse. Yet even here the positivist doctrine has triumphed, because these higher dimensions of space-time have become unnecessarily 'compactified' to explain why they cannot be sensed, perceived or directly observed. The final acceptance and advocacy of higher dimensions, even in their 'compactified' form, is an integral part of the recent failure of quantum theory to progress independent of relativity as well as a quantum's answer to the recent surge of relativity theory.

The surge

Since the 1960s, relativity theory has experienced rising fortunes. A new attitude about relativity has emerged. It is clearly evident that both general and special relativity were impractical before the 1960s. When Einstein died in 1955, only two universities in the United States offered courses on general relativity. Time dilation had only been confirmed in the late 1940s when mesons created in the upper atmosphere were detected at the surface of the earth. The concept of the expanding universe was well accepted, but an alternate explanation was also popular. What is now called the Big Bang theory was not a foregone conclusion as it is today since it was being challenged by the steady state theory. So the popularity and acceptance of general relativity was anything but overwhelming within the scientific community.

When Einstein developed general relativity he made three predictions. The first, the advance of the perihelion of Mercury was already known, so it readily confirmed Einstein's theory. The second prediction, that light rays would bend around massive objects such as the sun, was verified in 1919 by Sir Arthur Eddington. Yet the third prediction, that light coming out of a gravitational well would be shifted toward the red end of the light spectrum, had not yet been verified. The third prediction was only verified in 1959 with the Pound-Rebka experiment at Harvard. Technology had finally advanced to the point where R.V. Pound and G.A. Rebka could measure the red shift of light between the bottom and top of the tower of a building at Harvard University. This experiment ushered in a new era of precision tests of general relativity. When these new precision tests are combined with the space exploration program and new and more accurate methods of observation in astronomy, a surge in the scientific knowledge and acceptance of relativity theory developed. Relativity had finally come of age. Quite simply, relativity theory had finally become practical in everyday science. Even the successes of general relativity in cosmology in the 1920s and 30s were not enough for relativity to challenge the priority and fundamental status of the quantum paradigm, but now the playing field was beginning to level out. Cosmology had always been far away from everyday life and thus impractical, but the space program brought cosmology and astronomy into everyone's homes.

On the other hand, quantum theory had always been closer to the world of experience and useful for understanding the atom. Quantum theory was also progressive during the period. Quantum field theory was developed in the late 1940s and quantum chromodynamics emerged in the 1960s. The weak nuclear force and electromagnetism were unified as the electroweak force, followed by unification with the strong nuclear force in the 1970s. Hope grew that the quantum theory would become the basis for a total unification of physics, *i.e.*, lead to a single theory to explain all four natural forces (or interactions). So quantum scientists adopted Einstein's concept of unification, but differed from Einstein's continuous approach to the field by basing unification on the fundamental principle of discrete particles. In the late 1970s, the 'supergravity' theory was developed to unify physics, but this theory failed. However, the 'supergravity' theory adopted an eleven-dimensional Kaluza-Klein model for space-time, legitimizing the concept of higher dimensions of space and space-time in physics. In the 1980s, the superstring theorists adopted the notion of 'compactified' higher dimensions using the same Kaluza-Klein theory as their basis, further legitimizing the concept of higher dimensions of space and space-time, but these theories, along with their 'brane' theory progeny, have also failed. So it would seem that quantum approaches to unification have come up short handed, but mysteriously very few scientists have turned to the alternate view of approaching unification from the relativity

(continuity) point-of-view.

Relativity had barely begun to challenge the quantum dominance of physics in the 1970s when unification became a popular subject and goal for the quantum theorists. Quantum theorists realized that they could not do without relativity, but nor could they do with it, so they adopted Einstein's goal of unification. The scientists proposing quantum unification surely saw this as the next step in the progress of quantum theory and have laid claim to be Einstein's heirs in the attempt to unify the quantum and the relativistic gravity field, but they are not approaching unification from the same direction or path that Einstein intended. They are not legitimate heirs to Einstein's ideas. The quantum paradigm still remained so strongly entrenched that very few scientists have dared to seek unification from the point-of-view of a strict physical interpretation of relativity theory. Relativity theory still has to breach the barrier of physicality that was established by the positivistic notion of intrinsic curvature decades earlier. Real curvature is extrinsic and requires a higher dimension of space or space-time. However, nature began to intervene on behalf of relativity theory at this point in time when scientists discovered Dark Matter (DM).

In the 1970s, Vera Rubin and Kent Ford observed that stars in the rims of spiral galaxies moved at roughly constant speeds as if large quantities of invisible matter surrounded the galaxies in 'halos', but no corresponding matter had ever been observed. Their 'discovery' was not new because the phenomenon had first been noted by Fritz Zwicky and Sinclair Smith in the 1930s (Zwicky, 1933; 1937a; 1937b; Smith, 1936). Zwicky had predicted the existence of some type of dark matter that affected the motion of stars in the arms of spiral galaxies. The existence of these halos was further confirmed when clusters of galaxies were observed to exhibit motions that could require as much as ten times the material content of the visible portions of the galaxies that makeup the clusters (Oort, 1940). However, this fact was not confirmed until the 1970s by Rubin and Ford. This anomaly was confirmed by further observations and the concept of galactic 'halos' and DM was born (Rubin and Ford, 1970; Rubin, et.al., 1985). Scientists assume that the halos are made of Cold Dark Matter (CDM) since no apparent source of these gravitational attractions is visible. The 'matter' in the halo is assumed cold because it has no discernible (or very low) kinetic energy, *i.e.*, it is devoid of motion, whatever it is. It is dark because it neither emits nor reflects visible light nor other electromagnetic waves. The gravitational source is assumed to be material simply because science knows of nothing other than matter that can act gravitationally, so there is little reason to believe that CDM is the same as normal baryonic matter.

The mystery was further complicated by the discovery of what has been described as Dark Energy (DE) characterized by a negative pressure just a decade ago. This latest twist occurred in 1998 when teams headed by Saul Perlmutter and Adam Riess detected an increase in the expansion rate of the universe (Perlmutter, et al, 1999; Riess, et al, 1998). Both groups were investigating redshifts exhibited by Type Ia supernovae and noticed that these redshifts were dimmer by a small amount from that expected. The values thus obtained could only be explained by assuming that the expansion rate of the universe is increasing. The discovery was completely unexpected since the standard model of cosmology posits that the expansion should be slowly decreasing due to gravitational attraction. The only thing that could counteract gravitational attraction would be a small negative pressure and the concept of DE was born. The discoveries

of both the CDM halos and DE have been at complete odds with general relativity since their discovery. They indicate two possibilities, something is wrong with general relativity or it is incomplete, yet general relativity seems perfectly valid in all other respects.

On the one hand, the discoveries of DM and DE have given particle physicists cause to rejoice in that they demonstrate problems with general relativity that quantum theorists hope to solve from their own quantum perspective. They also give quantum theorists a new reason to invent new particles to add to their particle zoo (such as WIMPS and accelerons), if not find new uses for previously suspected hypothetical particles whose existence and properties have not yet been verified (such as axions). On the other hand, there is no reason to believe that the DM and DE anomalies have anything to do with particle physics. Both problems seem to be more amenable to relativistic solutions. In fact, particle physicists have had to apologize for their inability to predict or explain the phenomena and are at a true loss to explain either anomaly. Yet the problems of DM and DE must be solved because they have been detected in nature and nearly everyone agrees that solving either of these problems, or both, will cause a scientific revolution.

From a strictly historical point-of-view, it is curious why no one questioned the fact and straightforward observation that galaxies have stable spiral arms in all the years that they have been observed. The fact that spiral arms even exist should have indicated that something was wrong with the rotation speeds of the stars and star systems that constitute the arms. Yet this simple fact went unnoticed for five decades before Rubin and Ford made their observations. Until the 1970s, science seemed blind to the modified speeds of stars that form galactic arms and imply the existence of the DM halo. These phenomena illustrate the dark side of science; the existence and nature of biased observations that must be made to fit the accepted paradigm or go unrecognized (even when they are made subconsciously). In this case, science has only become mature enough to accept the existence of these obvious anomalies in the past few decades as the positivistic influence over science has weakened.

The stage has been prepared for a new revolution in science with the discoveries of DM and DE. The 'crises' for modern science have thus been identified and they have been recognized as revolutionary, such that either radical modification of old theories or a new theory needs to be developed to explain them. In any case, people now realize that a revolution will come in the form of a new theory of matter because nature has forced the ultimate nature of matter into the forefront of science with DM and DE. Yet experience has taught us that a theory of matter can be neither had nor complete without considering the role of the consciousness that perceives matter and material reality, so the next revolution will encompass both matter and consciousness.

The Third Revolution is engaged

Scientists and academics alike missed the boat during the Second Scientific Revolution, although that assessment may be too harsh. Perhaps it would be more accurate to say that they just were not ready or prepared to take the ride that nature and the circumstances of their own successes offered them. Whichever the case may be, they did not directly address any scientific questions directly related to either mind (consciousness) or matter. They skirted the issues. The

desire to bypass these thorny issues is so strong that some scientists still try to circumvent nature and the clues nature provides them that they are willing to claim that ‘mathematics is the reality rather than the physical world’ or that ‘physics is really about information or processes’, not about ‘things’. These philosophies may look tempting and they may even work for a while, like quantum mechanics has worked for the past several decades, but nature would ultimately bring science back to the old standards of mind and matter if such philosophies were ever accepted by science. Such esoteric opinions are just not good physics, if they can be considered physics at all. Solving a problem by denying its existence is not solving the problem at all, it is just delaying the real solution. These mentalizations of physical science are not about answers, but about excuses for not finding answers. Yet some scientists still try to propose these tactics to obfuscate physics and press their own agendas. From the historical point-of-view, such proposals are indicative of the frustration and consternation that scientists are presently feeling for the lack of progress toward the scientific goal of unification, The search for unification seems stymied at present and will remain stymied as long as unification goes forward on the basis of the quantum hypothesis.

According to the prevailing attitude in the physics and general scientific communities today, physics as it is, in the form of quantum field theories and the Standard Model, are highly successful. In fact, most scientists believe that quantum theory is the most accurate theory ever developed, accurate to twelve decimal places. Furthermore, many scientists believe that quantum theory will eventually solve all the problems that nature presents it with. They also believe in the eventual development of a ‘theory of everything’ (TOE) based on the quantum theory and the discrete nature of reality that forms the basis of the quantum hypothesis. DM and DE can and will eventually be explained by WIMPs, MACHOs, neutrinos or some other quantum particles. These hopes are commonly and openly expressed within the physics community today and stories about these new wonders of physics are common fodder in the popular scientific media (magazines, journals and television documentaries about science). Fortunately, getting good press does not constitute scientific verification. Within the more general scientific community, it is also commonly understood that the study of consciousness is rapidly growing as a new branch of science, but it is not limited to psychology. Consciousness studies, as it is called, is instead a multidisciplinary field. The human genome project and other advances are also changing biology and related fields. Under these circumstances, many scientists, scholars and academics have predicted that a revolution in science is coming, but they do not take their claims as seriously as they should.

To illustrate the point, numerous historical parallels between the situation in science today and the situation in science just prior to the Second Scientific revolution have become apparent in recent years. These parallels are not just coincidences, but rather historical markers that would normally precede scientific revolutions. If physics in the form of quantum field theories and the Standard Model are highly successful, so was Newtonianism in 1900. Most scientists believe that the quantum theory is the most accurate theory ever developed, accurate to twelve decimal places, but then so was Newtonianism in 1900. It does not matter that many scientists believe that quantum theory will eventually will solve all the problems that nature presents it with, the scientists of 1900 also thought that Newtonianism would solve all possible problems in nature just prior to the last revolution. Modern scientists also believe in the eventual development of a ‘theory of everything’ (TOE) based on the quantum theory and the discrete

nature of reality that forms the basis of the quantum hypothesis, but then Newtonianism was thought to be universal in 1900. Newtonian physics was in essence a TOE in the minds of scientists a century ago. Nor does it matter that particle physicists believe that DM and DE can and will eventually be explained by WIMPs, MACHOs, neutrinos or some other quantum particles. Planck was just doing thermodynamics when he solved the blackbody paradox in 1900, while Lorentz and Fitzgerald solved the aether problem of their day within the Newtonian paradigm. The older solutions do not forestall a scientific revolution and the subsequent changes in paradigms. The new paradigm will re-solve the old problems according to its own tenets. While the study of consciousness is rapidly growing multidisciplinary branch of science today, it strictly parallels the early multidisciplinary development that established psychology as a science in the late 1900s. And finally, academics in the late nineteenth century had to deal with the ramifications of human evolution and Darwinism, while scientists today are dealing with the ramifications of mapping the human genome and related advances in the life sciences. It is *déjà vu* all over again. If these indicators are to be believed, science is clearly on the verge of a Third Scientific Revolution, if that revolution has not already begun. The parallels and the historical signs and trends are just too great to ignore.

Conclusion

If we follow the recent historical trends within science to their logical conclusion, some notable features of the coming revolution begin to emerge: The last scientific revolution was left incomplete due to an overzealous positivistic response to new theoretical work in describing nature. Thus seeds were sown for a new revolution in the future and the new revolution is presently at hand. Whether the new revolution began yesterday, will begin today or will begin tomorrow is an unanswered question. But it is quite possible and quite reasonable that the Third Scientific Revolution has already begun. Recent historical trends indicate that the quantum paradigm's fundamental hypothesis is failing while the relativistic point-of-view is gaining an ever larger and more serious scientific audience.

The Standard Model of quantum theory has been shooting blanks with its predictions for the past several years and seems to have reached a plateau of accuracy some time ago, while general relativity is just becoming more and more accurate with recent experiments. All attempts to quantize gravity have utterly failed and compromise approaches such as quantum loops, superstrings and brane theories that attempt to retain or explain the continuity of relativity while saving the phenomena and particle structure of quantum theory have gone nowhere in spite of their phenomenal popularity. They are incapable of rendering testable predictions. So it would seem that the quantum point-of-view of physical reality is slipping while the relativistic point-of-view is surging. In this picture of an emerging Third Scientific Revolution, the Standard Model is the 'aether vortex' theory of this era and quantum loops, superstrings and branes are the idle speculations resulting from a paradigm in trouble and grasping at straws. They are all competing theories and thus the hallmark of a pre-revolutionary period, but the real competition is between the quantum hypothesis of the discrete nature of reality and the relativity hypothesis of the continuous nature of reality. So the real competing theories are the quantum theory and relativity, which offer mutually exclusive views of nature. And, of course, we have the modern 'crises' that precede the revolution in the form of DM (the modern parallel with the luminiferous aether problem) and DE (the modern parallel with the blackbody paradox). From these comparisons it

should become evident that a revolution is indeed in the making if not already in progress.

The advantage of studying recent historical trends in physics is that they point the way toward the new theory and paradigm, whether it has already been proposed, or not. The trends indicate that the new theory (paradigm) will be based upon continuity and the relativistic concept of field, although it will be a completely physical concept of field, *i.e.*, the field will be characterized by physical constants such as permittivity, permeability and Planck's constant. The field will be hyper-dimensional and non-Euclidean. Curvature will be an extrinsic property of the four-dimensional space-time continuum, thus requiring a physical interpretation of relativity theory and curvature. And finally, this revolution will be as much about consciousness and mind as it is about matter, realizing the aspirations of the minority of scientists who studied mind before the last revolution. DM and DE will be defined and explained, but so will the mind and consciousness that observes and perceives them, rendering this the most significant revolution of all.

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