Millennium Madness: Much ado about nothing!

An Editorial

The human race stands on the threshold of a new millennium of history. Big Deal! Nothing really changed when the clock struck 12:00:00 A.M. on the night that the year 1999 passed to the new year of 2000, except perhaps for our perception of our place in the world. Nor will anything magical, mystical or conspiratorial occur as this new millennium progresses. As Shakespeare would say, we are making "Much ado about nothing." First of all, consider the controversy over the date that the new millennium begins. Does it begin in 2000 or 2001?

As the story goes, the creator of our calendar opted to choose year number one as the initial date for his calendar, rather than the year zero. So technically, the new millennium begins in 2001. Balderdash! Bah! And humbug! There is no law of nature that requires the human race to follow the dates set by someone who could not even count by today's standards. It seems that those who tell this story have forgotten to include the small fact that the number system that we inherited from the Greeks and Romans had no zero. The number zero was adapted from the Hindu and Moslem number system during the late middle ages. So, there could not have been a year zero on our original calendar and the creator of the calendar never made a conscious choice between the years zero and one. For us, then, the choice of 2000 or 2001 as the beginning of the millennium appears random, as does the original date of the calendar. Any choice of dates depends on the state of knowledge at the time of the event, but knowledge changes relative to time so the original choice of year one as opposed to year zero was random relative to our present state of knowledge. Since our original calendar started with year one because there was no concept of a number zero, there is no reason why we cannot choose to 'post date' the beginning of our calendar to year zero now that our number system includes a zero. Therefore, we can legitimately claim that the millennium began with year zero. And further, since there is no specific date or event to which our present calendar is tied, there can be no argument to this logical solution to the controversy.

The original date was supposed to have commemorated the birth of Jesus, but all evidence now leads scholars to believe that Jesus was born as early as four or seven years before year zero. In other words, the next millennium could have started anytime after about 1992 or 1993, as nearly as we can tell, so whenever we now choose to say 'the millennium begins' then it begins. Besides, it is only the year 2000 according to Christian beliefs and Christians represent far less than the majority of humans in our world. Many non-Christians have chosen to accept the year 2000 as the beginning of the millennium for political and economic reasons. So the year 2000 has evolved into the beginning of the millennium by worldwide acclamation. Out of political respect for the non-Christians of our world who have adopted our calendar for their standard, we no longer even use the terms BC and AD which have religious connotations, but have changed to the 'politically correct' terminology of BCE (before the common era) and CE (common era), respectively. This new terminology underscores the fact that our calendar has been stripped of its Christian origins and evolved into a more secular and random dating system. So once again, our choice of year one or zero as the opening date of the first millennium is random and there is no logical or religious necessity to distinguish between 2000 and 2001 as the beginning of the third millennium.

Christianity has served to spread the fundamental Greek philosophies upon which western science and our basic worldview are founded throughout and the whole world. In other words, the attitudes that western civilization holds dear regarding our place in the universe and physical environment, as well as our relations with each other, are based on ancient Greek and Roman philosophical ideals. And our philosophical ideals, at least in science, have been changing by a process of evolution relative to our progressing state of knowledge. The pace of this evolutionary process in thought has increased tremendously over the past three decades.

On one hand, holistic non-western points of view have strongly influenced western science since the 1970s, but even these simple changes are actually part of a greater and far more complex change of attitude. Scientific attitudes are evolving and changing ever more rapidly as we realize our place in a larger and far more complex universe than science could have imagined at the beginning of our present century and the birth of what is commonly called "modern" science. When the twentieth century began, science did not even know that our Solar system is located at the edge of a galaxy that is only one of millions of galaxies that make up our universe. In 1900, our sun was thought to be just one of millions of stars that made up the known universe. Such new discoveries have forced science to evolve at a far greater pace than ever before and this evolutionary process affects both society and the complex infrastructure of our interrelated cultures. In the past few decades, the pace of change of our knowledge base has nearly reached a revolutionary pitch, all that is needed to change the process of evolution into a revolution is one small factor which can bind all of the different evolutionary trends into one political event, discovery or radical scientific theory. Civilization as a whole is built upon our philosophical attitudes and these are both a product of science and reflected in science. If the new millennium is meant to represent some significant change in our society, culture or civilization, a more realistic view of the change of millennium is not a specific date, but our attitude toward a specific date as it marks changes in culture and science.

With the possibility of a new scientific revolution looming so large in the near future, the year 2000 only offers a convenient point in time to stop and take notice of where we have been and where we are going. The fact that the most radical changes are occurring within a few decades of such an auspicious calendar date as the year 2000 is merely coincidental. The year 2000 merely gives us a convenient date to mark the change; it does not affect the change in any way whatsoever. But this analysis of events does beg the question, how can this change in scientific attitude be recognized, described and categorized?

At the end of the last century, the scientific community thought its work was all but complete. The theories of Newton and Maxwell as well as thermodynamics were so successful that many scientists assumed they only needed a few more accurate measurements to completely describe our universe. In other words, as of 1900 scientists only had to dot the i's and cross the t's in the story of nature, or so they thought. In its explanation of our world, the book of nature had been read and understood in its totality by science. So, as the nineteenth century yielded to the twentieth, scientists and scholars thought that they could only look forward to the application and further elucidation of the laws of nature as they were already understood at that time. The beginning of the twentieth century thus became an occasion to summarize what science had already accomplished up to that time and speculate to what uses known science could be put in the future. Scientists and scholars would not even consider the possibility that their sacred laws of nature were subject to fundamental changes.

No nineteenth century scientist or scholar expected, let alone suspected, the changes wrought by relativity and the quantum in the first decade of the twentieth century while all of the accomplishments and changes that have come since then were completely beyond all human powers of imagination. The early advances in 'modern' physics at the turn of the last century were not alone, but were accompanied by other changes in science and culture, which together became the Second Scientific Revolution. The birth of psychology and the rediscovery of genetics are but two examples of the other fundamental changes in science that contributed to the new revolution in thought. However, the fundamental changes in physics did set the tone for all of science during the coming decades and provided both a program and a new paradigm for the scientists of the twentieth century to follow.

That new program has been successful far beyond any predictions that could have been made; yet we now stand at approximately the same position relative to our science that the scientists of the nineteenth century stood relative to their science. Some modern scientists think that we are presently ready to complete science with just a few more accurate measurements, the modern scientific equivalent to dotting the i's and crossing the t's in our understanding of nature. These scientists have all but closed the book with their own conceptions of a "Theory of Everything" or they believe that such a TOE, based on present theories of the quantum, is just around the corner. However, the very successes that science has made in the past half century are already leading toward a new revolution in science, which is evident in changing attitudes within the scientific community. Those scientists who presently believe that they have discovered the ultimate TOE have not learned from the past and are thus condemned to repeat the shortsighted mistakes of the past.

The roots of the Second Scientific Revolution can be found, through the hindsight of historians' eyes, in the successes of nineteenth century science. Newton and Maxwell's theories were successful in their own domains, but in those areas where both could be applied to the same phenomena they gave contradictory results. These overlapping areas of application are exemplified by two looming crises at the end of the nineteenth century, the failure of the Michelson experiment to detect the luminiferous aether and blackbody radiation. These two crises helped set the stage for the development of relativity and quantum theory, respectively. However, relativity and the quantum theory were not true theories of unification. They only represented the act of rendering the theories of Newton and Maxwell compatible in their common areas of application. The question of a total unification was left both unasked and unanswered while the new areas of relativity and the quantum were explored individually and independently. On the other hand, both quantum theory and relativity have proven extremely successful, but again their successes have engendered new problems that have only been recognized in general in the final decades of the twentieth century. Quantum theory and relativity cannot be unified given our present paradigm of science. Attempts have been made, but all have fallen woefully short of the goal. These failures strongly imply that a new direction of attack on this growing problem is necessary.

Throughout the middle decades of the twentieth century, quantum theory produced the greatest and most spectacular successes in all of science, so the quantum perspective of nature came to dominate the science of physics. The major emphasis of unification has thus come from the quantum perspective of reality. Modern unification is to be found in science's attempts to describe the natural forces as 'quantum fields,' a phrase which is itself an oxymoron. The quantum is discrete while the field is continuous, two concepts which are mutually exclusive and completely incompatible. Except for a small handful of scientists, the limited successes of QED, QCD and a few other quantum theories have blinded the scientific community to their inherent logical contradictions. Without exception, the attempts at unification from the quantum perspective have failed to adequately unify physics. They have had important but limited successes in some areas, but they have not provided the ultimate unification that they first promised. All the limited successes that these theories (the standard model, grand unification, supergravity and superstrings) have enjoyed have depended upon seeking smaller and smaller units of material existence coupled with the mathematical stitching necessary to hold the discrete material units together.

At some point of this endless reduction of our physical reality, scientists will come to realize that their theories are only becoming more exact and accurate as they approach a point where the smallest suspected units of physical reality reach their limit in the continuity of the true field. At that time, scientists will realize that Einstein was correct and they will again found the ultimate theory of reality on the basis of relativity rather than the quantum, the continuous rather than the discrete. When science realizes this simple fact, it will return to pure Einsteinian field theory as the fundamental basis of unification. That is what the twenty-first century holds in store for science and a few twentieth century scientists have already come to realize that this fundamental change in attitude is inevitable and rapidly approaching. They have already detected these changes in recent trends of research.

When the scientific advances of the past half-century are taken together, various significant trends become evident. Among these research trends, the two most important within the field of physics are the renewed search for a unification theory and the search for a physics of consciousness. The search for unification is quite old, but only Einstein and a few colleagues conducted searches for unification, independent of advances in quantum theories, from the 1920s through the 1960s. It was only after about 1970 that unification became a recognized goal by quantum theorists, who, in recognition of Einstein's stature and respect for his ideas, mistakenly considered themselves heirs to Einstein's quest toward unification. But Einstein would never condone or accept quantum mechanics as the fundamental method of unification. So such claims by quantum theorists are completely without merit. The path toward unification that they follow is not Einstein's path but rather a normal trend of all science toward unification of one type or another.

Quantum theorists presently assume that the quantum is more fundamental in nature than the field. They also wrongly assume that a successful field theory will whisk away their own successes, so they will not even consider the possibility that the field is more fundamental than the quantum. They are overprotective of their successes in science. However, a successful field theory need not conflict with the many documented successes of quantum theory. True unification will proceed with both quantum theory and the field intact, finding a median between the two. The quantum theory will be left intact by a successful field theory because a field theory must incorporate and explain the successes of the quantum theory before it could even hope to be accepted by the scientific community. In fact, quantum theory will emerge as a more complete and stronger theory after the completion of a unified field theory, even though the field will be found more fundamental to the nature of physical reality. It is unscientific to deny the possibility that physical reality might be continuous rather than discrete at its most fundamental level when the discrete approach has not been able to describe reality at that level after a half-century or more of attempts.

Any true unification theory, at least if it claims to be a true TOE, must also deal with the facts of life, mind and consciousness. Unification in physics must lead to a unification of all the sciences in the end and thus go quite 'beyond' what is presently regarded as the discipline of physics. So any successful unified field theory will be 'para' physical by the very nature of the concept. Paraphysics is the branch of physics that goes beyond describing our world in terms of the fundamental concepts of matter and 'matter in motion.' Classical physics has always ignored the concepts of life, mind and consciousness in its explanation of physical reality, as has 'modern' physics. Within these areas of 'normal' physics, the mind/matter problem has had a long and notorious career. Consciousness is a part of this dilemma, even in quantum theory since quantum mechanics still depends upon a classical concept of matter as a particle. In paraphysics, both matter and motion are reduced to still more fundamental quantities where life, mind and consciousness will find scientific explanations.

The problem has traditionally been solved in physics by completely separating mind and matter. Classical physics deals with either simple dead (or inanimate) matter or the inanimate material aspects of living bodies. It is quite ironic that the success of the quantum theory has reintroduced the concept of consciousness into the melting pot of physical reality that is the domain of physics, completely bypassing the old mind/matter dilemma. It would seem that quantum theory requires consciousness, at least at some level, to collapse the 'wave packet' or make some other choice between different possible quantum states of a system. So the concept of consciousness has again become a popular topic among many physicists in spite of the traditional mind/matter split. This trend in physics corresponds to an overall rehabilitation of the concept of consciousness by other disciplines of science, which have met with their own successes. There is now an international and interdisciplinary movement seeking to discover the nature of consciousness and physics is an integral part of that movement.

These two trends, unification and consciousness, seem to be converging with other trends in science, so it is logical to predict that a Third Scientific Revolution will result from the merging of these various trends. Many scientists and scholars regard this past century as having been dominated by physics, a fact that seems beyond question, but many also claim that questions and advances in the life sciences will dominate science and philosophy the next century. They are both right and wrong. The merging of physics, the other physical sciences and the life sciences will mark the true advances of the next century and millennium. Nature does not draw boundaries between the various scientific disciplines; nature is one, a whole in itself without internal division. Humankind has placed phantom non-existent restrictions on nature and thus built the distinctions between these academic disciplines in order to reduce nature to a manageable size for study. As the various sciences progress, they will eventually merge and we will come to view nature and our world as a whole which is more than the sum of its parts. These trends exemplify the changing attitudes that are beginning to guide science as we move from the second millennium to the third. The year 2000 is thus destined to mark a convenient point of reference for historians of the future whose duty it will be to investigate, document and explain these fundamental changes in science, technology and culture.

If there is any question regarding the validity of this analysis, one need go no further than the "End-of-the-Millennium" issue of *Scientific American*. The December 1999 issue is dedicated to "What science will know in 2050" rather than 'what science accomplished during the twentieth century.' Several articles written by respected scientists express views of what the beginning of the twenty-first century holds in store for science. One of the articles, by Sir John Maddox, documents the expected unification in physics within the context of science as a whole. He states that "the central problem in fundamental physics is that quantum mechanics and Einstein's theory of gravitation are incompatible with each other" (Maddox, 67) and "The most important discoveries in the next 50 years are likely to be ones of which we cannot now even conceive." (Maddox, 62) He specifically notes the failures of previous attempts to unify the laws of nature even though these theories are normally considered the greatest successes of quantum physics.

> That is also the case for the central problem in fundamental physics, which stems from the fact that quantum mechanics and Einstein's theory of gravitation are incompatible with each other. So much has emerged from the failed attempts to "quantize" the gravitational field in the past two decades. Yet without a bridge of some kind between these two theories, two of the triumphs of our century, it will not be possible to describe the big bang with which the universe is supposed to have begun with anything like the customary rigor. Doubt has also infected particle physics, where for many years researchers have shared the goal that all four forces of nature should eventually be unified. Those laboring in the field of string theory believe their work provides an acceptable bridge, but others point to the waxing and waning of enthusiasm in the past 20

> years and are less sanguine. At least the next 50 years should show which camp is correct. (Maddox, 67)

Even Steven Weinberg admits, "a unified theory of forces will probably require radical new ideas" (Weinberg, 68) even though he still supports the cherished quantum perspective of physical reality as described by the "standard model."

Scientists have come to the understanding that answers to questions regarding the nature of reality in the realm of the very small will also answer questions about the grand cosmological scheme of nature. According to Martin Rees,

> The progress in cosmology has brought new mysteries into sharper focus and raised questions that will challenge astronomers well into the next century. For example, why does our universe contain its observed mix of ingredients? And how, from its dense beginnings, did it heave itself up into such a vast size? The answers will take us beyond the physics with which we are familiar and will require new insights into the nature of space and time. To truly understand the history of the universe, scientists must discover the profound links between the cosmic realm of the very large and the quantum world of the very small. (Rees, 80)

There can be little or no doubt that Rees' "links" are equivalent to Maddox's "bridges" between the theories of the quantum and relativity and Rees' reference to "new insights into the nature of space and time" refers more directly to relativity theory than to the quantum. Both men prescribe the same future for physics in their concern that physics must be unified in the near future, and the unification of physics will incorporate far more than one might expect at this point in time.

Nor were questions on the physics of consciousness ignored in the *Scientific American* articles. Non-physicists like Antonio R. Damasio clearly recognize the contribution that physics must make to any science of life, mind and consciousness.

> We are barely beginning to address the fact that interactions among many noncontiguous brain regions probably yield highly complex biological states that are vastly more than the sum of their parts.
>
> In fact, the explanation of the physics related to biological events is still incomplete. Consequentially, declaring the conscious-mind problem insoluble because we have studied the brain to the hilt and have not found the mind is ludicrous. We have not yet fully studied either neurobiology or its related physics. For example, at the finest level of description of the mind, the swift construction, manipulation and superposition of many sensory images might require explanation at the quantum level. Incidentally, the notion of a possible role of quantum physics in the elucidation of the mind, an idea usually associated with mathematical physicist Roger Penrose of the University of Oxford, is not an endorsement of his specific proposals, namely, that consciousness is based on quantum-level phenomena occurring in the microtubules - constituents of neurons and other cells. The quantum level of operations might help explain how we have mind, but I regard it as unnecessary to explain how we *know* that we own mind - the issue I regard as most critical for a comprehensive amount of consciousness. (Damasio, 114-115)

Clearly, there are problems in the science of consciousness and physicists will eventually play an essential role in overcoming those problems. Maddox also notes this fact.

> The catalogue of our ignorance must also include the understanding of the human brain, which is incomplete in one conspicuous way: nobody understands how decisions are made or how imagination is set free. What consciousness consists of (or how it should be defined) is equally a puzzle. Despite the marvelous success in the past century (not to mention the disputed relevance of artificial intelligence), we seem as far from understanding cognitive process as we were a century ago. (Maddox, 66)

Both of these scientists recognize the relevance of consciousness to any complete theory of reality that could evolve in the future.

Maddox introduced still another aspect of the consciousness chase, the role of artificial intelligence in the scientific debates on the subject, while Hans Moravec discussed this aspect more directly in his paper on robotics.

> The issue is controversial in some circles right now, and there is room for brilliant people to disagree.
>
> At the crux of the matter is the question of whether biological structure and behavior arise from entirely physical law and whether, moreover, physical law is computable - that is to say, amenable to computer simulation. My view is that there is no good scientific evidence to negate either of these propositions. On the contrary, there are compelling indications that both are true.
>
> Molecular biology and neuroscience are steadily uncovering the physical mechanism underlying life and mind but so far have addressed mainly the simpler mechanisms. (Moravec, 127)

So it would seem that computers and the robots that they will control in the near future are also part of the overall trend in science toward an understanding of consciousness that will include a physics of consciousness. Such a physics of consciousness will ultimately depend upon the unification of physics.

There is no doubt that the dual trends of unification and consciousness are clearly discernible in the *Scientific American* articles. But even more important, the editors of *Scientific American* have taken a view of the future for their last issue of the twentieth century rather than dwelling on the past. This strategy emphasizes the most significant aspect of the changing attitude of science, its hope and emphasis on the future. It is in this manner that science at the end of the twentieth century varies most radically with science at the end of the nineteenth and earlier centuries. Our changing attitudes can be measured by the fact that we now look forward to the future to at least as great an amount as we look at our past accomplishments. We see our past accomplishments as a continuous evolution dotted by an occasional revolution and ask where that evolution is taking us.

It is mentally healthy for an individual to look to the future rather than dwelling on the past and it is the same for science and culture as a whole. This aspect of the change in scientific attitude demonstrates the general good health of the new attitudes in science. We know that we are doomed to make the same mistakes again if we ignore our history, but that fact does not mean that we should ignore the mistakes of the past. It only means that we should not dwell upon them. Learning from history is looking to the future, while not learning from history is repeating the past. We cannot look to some 'golden age' of the past when things were perfect and move backwards by trying to relive that past. We could never recreate these 'golden ages' even if they did exist, which they did not. It is healthy to study the past, so that we need not repeat the mistakes of the past because we will repeat them if we do not study and understand their dynamics within both science and culture. It would be a disastrous mistake to think as the scientists thought a century ago that science was all but complete in its present stage.

A good example of our forward-looking attitude can be found in the rise of science fiction during the past century and its popularity. Science fiction is very forward looking and presents an important method for culture to test different scenarios for the future. When we finally reach the future that is depicted in science fiction, we will find that a scientific revolution occurred in the early decades of twenty-first century of the third millennium, which began in the year 2000. For science, any significance in the date 2000 reduces to the fact that the year 2000 makes a convenient handle to note historical events, scientific events and various blips in the otherwise continuous progress of human thought and understanding. Even knowing this, I will still celebrate 2001 as the beginning of the new millennium, along with many other people, just as I celebrated the year 2000 as the beginning of the new millennium, because it does not really matter when the millennium begins. It is just a good excuse to party. The real millennium occurs in the new attitudes that the future holds and knowledge that they will bring us.

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