

# A NEW PHYSICS AND A NEW THEOLOGY

## FOR AN EVOLVING UNIVERSE

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### *The Setting. Life in the Universe.*

Interest in the discovery of extraterrestrial life is clearly on the increase. The recent announcement of the possible detection of organic material in the meteorite ALH84001, almost undoubtedly of Martian origin, has heightened the interest. The presence of life elsewhere in the universe holds a fascination not only, and perhaps not even principally, from a scientific perspective but also from a psychological, philosophical and religious one. In some sense the quest for life elsewhere has more to say about our knowledge of ourselves than about our knowledge of the universe and our place in it. And yet the real marvel is not that there may be life elsewhere in the universe, but rather that there is life at all in the universe. To be more precise, according to an acceptable (but not an altogether certain) cosmological time scale at about twelve billion years after the Big Bang, or about 80 percent of the current age of the universe, the first microscopic life forms came to be on the surface of the Earth. The fact is that it took that long in the evolution of the expanding universe to establish the conditions for life to begin and in that long evolution very precise physical circumstances had to continuously prevail in order for life to appear. One can, of course, reflect upon this in one of two ways. Life is simply the insignificant tail end of a long evolutionary process or life is the culmination of an extremely long and delicate unravelling of the innate physics of the universe. In either case there is objective evidence for marvelling.

Thus the real marvel of life is not in space but in time. There is simply no convincing scientific explanation of how the universe evolved with such continuous precision over twelve billion years so as to give birth to life. And so we are left to marvel that it happened at any place at all in the expanding universe. It would surely be a sensational scientific achievement to obtain clear evidence of life elsewhere than on the surface of the Earth, but in my opinion it would only enhance the marvel already described of how life came to be at all.

### *An Evolutionary Universe.*

It is against this general picture of the place of life, and therefore our place, in an evolving universe that I would like to present the proposal of a new theology arising from a new physics. I recall when I was invited last year to give a public lecture in Louisiana, right in the heart of the Bible Belt of the United States, and upon my ready acceptance was asked to supply a title and abstract. I proposed as a title: "Our Place in the Evolving Universe". The question came flying back to me as to why I was trying to be provocative by using the E word. The E word, of course, was "evolution" and it was not to be mentioned lightly, if at all. My reply, of course, was that I would not mention it lightly; in fact, I would speak of it quite substantially since it was simply impossible to speak of our place in the universe without discussing the evolution of the cosmos, physically and biologically. I do the same here. While there are many details yet to be explained scientifically, some type of evolutionary Big Bang cosmology is the best explanation of our accumulated scientific knowledge of the universe.

There are three principal pieces of evidence which, when taken together, support the notion that the universe as a whole is evolving. These are: (a) the Hubble velocity-distance relationship; (b) the abundance of light elements in the universe; and (c) the three degree cosmic background radiation. The best explanation of these observations is that the universe began, if it had a beginning, in a hot dense state and that it has been expanding and cooling down ever since. In the course of that process, matter came to be out of energy, galaxies and stars formed, and you and I came to exist. In this process the emergence of organic material in general, and human beings in particular, seems to have required a very fine tuning of the evolutionary process itself. We do not have a definitive scientific explanation of that fine tuning and, therefore, we do not yet understand adequately the linkage of the human being to cosmic evolution. So much for the setting or background.

### *Historical Antecedents to the New Physics.*

The newness of the new physics, of which I will speak, cannot really be appreciated without some remarks on the history which brought about the new physics. At the birth of modern science in the 16th and 17th centuries, there was the persistent idea, as there had been for the Pythagoreans, that physicists were discovering some grand transcendental design incarnate in the universe. In fact, it is claimed that one of the essential factors in the birth of modern science was the Christian theology of creation

and of the Incarnation. In the latter case, the concept in St. John's Gospel of the Logos becoming incarnate was particularly appropriate and hailed back in some way to Platonic and Pythagorean concepts of the world of eternal ideas and of the transcendental character of mathematics. Indeed, Newton, Descartes, Kepler and others can be cited as viewing physics and mathematics in this way. Kepler for instance, saw geometry as providing God with a model for creation. He went so far as to see the circle as transcendently perfect, the straight line as the totally created and incarnate and the ellipse as a combination of the two, an incarnation in this world of what would have been the perfect geometry for the motion of the heavenly bodies in an ideal world. Newton was the epitome of this manner of thinking as he called upon the Deity as the only explanation of why the universe dominated by his law of gravity did not collapse. And yet the simple equations in which he expressed that law of gravity and the laws of motion redirected for future centuries the role of mathematics in physics. No longer was mathematics simply a description of what was observed; it was a probe of the very nature of what was observed.

This mathematization of physics will continue through the classical revolution in physics of the 17th and 18th centuries and will become, in a different way as we shall see, an essential ingredient of the new physics of the 20th century. As usual in scientific revolutions, what was happening only came to full realization after it had happened. A three-layered conception of the universe, only partially inherited from the Platonic-Pythagorean tradition, came to be accepted implicitly, and only slowly did it come to consciousness. There was the layer of the true mathematics, the mathematical structures of which the world is truly made. Then there was the second layer, the mathematics of we humans, structures which were in a Platonic sense only the shadows of the first layer. Finally there were at the third layer the images in concrete reality of the true mathematical structures which we humans attempted to understand with our shadow mathematics. (These layers should not be confused with the three degrees of abstraction of the Aristotelian tradition as I will attempt to explain below). However, there is a subtle development, described well by Michael Heller, in which at the second layer mathematics is not only the language or the interpretative tool of physics (the formal object in scholastic terminology) but it becomes also the "stuff" of the ideal world of physics (material object in scholastic terminology). For the present this "stuff" remained under the control of empirical verification i.e., the third layer, the images in concrete reality, remained the test of how true the human mathematical structures were.

The rise of quantum mechanics and of relativity theory at the beginning of this century soon weakened the connection between the second and third layers described above and, in fact, reemphasized the connection between the second and first layers. The images in concrete reality made very little, if any, sense as a test of mathematical "stuff" of the ideal world of physics. There are no natural images or representations which correspond to the Hilbert spaces, the mathematical "stuff" of quantum theory. And while general relativity has passed all of the experiments yet made to test its empirical predictions there are no adequate images or representations which correspond to motions at relativistic velocities or under very large gravitational forces. In its "purest" form the physics of both the sub-quantum world and the world "beyond-relativity" is strictly mathematical in the tradition of Plato and Pythagoras and has little to do with any sensory component.

I have mentioned parenthetically above that the various layers discussed in the previous paragraphs should not be confused with the Aristotelian three degrees of abstraction. For Aristotle, epistemology strictly reflected ontology; there were three levels of abstraction (and, therefore, three ways of knowing) corresponding to Aristotle's three levels of being: physics studied the world of the senses, mathematics studied geometrical structures, metaphysics studied the true essence of beings. Aristotle and the philosophical (and later scientific) traditions which followed him would not admit of an interpenetration of his first two levels of abstraction, sense experience and mathematics. This viewpoint differs radically from the schools of Plato and of Archimedes and it is critical to understand those differences in order to appreciate the new physics and the new theology that I will speak of shortly. Modern science, unconsciously rejecting the tradition of Aristotle, embraced that of Archimedes and, in most recent times, has been continuously more influenced by the tradition of Plato. Let me explain.

Archimedes, although judging by his literary style could be thought to be allied to the school of Plato, initiated a totally new way of viewing the relationship of sense experience to mathematics. Unlike Plato he saw mathematics, not as *a priori*, but as *a posteriori* to sense experience; but unlike Aristotle he saw that beyond rudimentary sense experience there was the ability to make quantitative measurements and that mathematics was the means by which those measurements led to understanding. It is undoubtedly the Archimedean way of viewing the relationship of sense experience and mathematics that has become the touchstone of modern science. The new physics has not abandoned or negated that Archimedean insight but it has added a Platonic element

to the understanding of mathematics. I am referring to what I mentioned above about the second layer, our shadow mathematics becoming, in Heller's felicitous expression, the "stuff" of the ideal world of physics and also to the fracture taking place between that layer and the layer of concrete images based on sense experience. I interpret this to mean that the ideal world of physics is becoming more and more Platonic and that the second layer of our shadow mathematics is becoming more and more to be thought of as the first layer of the pure and ideal mathematical structures. There are two areas of the new physics which exemplify these two tendencies: the search for a unified theory and the dynamics of non-linear systems.

### *The New Physics.*

The search for a unified theory which will include all known fundamental forces is essentially an attempt to find the ideal mathematical structure which is at the source of all created reality. Indeed, experimental results, for instance the discovery within the past years of a new quark, continue to urge on the quest. But one gets the distinct impression that the quest itself goes on in a very Platonic atmosphere of mathematical physics and that eventual empirical verification in our world of shadows of a unified theory is of secondary interest. It should be noted, however, that, in the tradition of Archimedes, the quest began with and is sustained by evolutionary cosmologies which have come forth from empirical quantitative measurements of essential parameters which characterize the universe, such as the time dependence of temperature and density in an evolving universe. In fact, it is thought that the unifying structure dates to a time very close to the Big Bang and that multiplicity came about by symmetry breaking as the universe cooled and became less dense.

The studies of the dynamics of non-linear systems has given birth to the fields of chaos theory and complexity. This represents, in some sense, a return from quantum physics to the world of macroscopic physics and it is, in another limited sense, a revindication of Aristotle's view that the world of the senses is too rich to be limited to or comprehended by mathematics. There are really two parts of this: deterministic chaos arising from classical mechanics and non-linear systems in thermodynamics. The immense variety of forms, shapes and structures which we find in both the inorganic and organic world challenges any theory that they could have come forth from some deterministic set of laws of physics. And yet, using the mathematical analysis of non-linear systems and the laws of physics, we can come to understand the structural

design for changes, but we cannot predict the result because we cannot know what result small perturbations, accumulated in a non-linear way, will produce. Thus while we can analyze mathematically and, in that sense, understand the structure of such dynamical systems, we cannot predict the outcome because of the accumulative effect of non-linear perturbations. In the end the world of the senses has a richness which defies ultimate mathematical analysis.

This brings us back to where I began. We know that we have life in the universe. Whether life is unique to the Earth in all the universe is insignificant to the following questions. Had we been given the initial physical parameters in an expanding universe at some time near the Big Bang (a few Planck times) could we have predicted that life would come to be? I assume that the honest quest for a unified theory means that we could have predicted the emergence and the exact nature and strength of the four fundamental forces and such fundamental physics as that. But is life the result of so many bifurcations in non-linear thermodynamics that we could not have predicted, even if we possessed the Theory of Everything and knew all the laws of microscopic and macroscopic physics, that it would come to be? I am asking questions somewhat different than those raised by the anthropic principle, whether taken in the weak or strong sense. The questions there have to do with interpreting and/or explaining the fine tuning of all of the physical constants and conditions required for the emergence of life. I am asking whether, given antecedently all of the physical constants and conditions necessary for life from our *a posteriori* knowledge of it, could we have predicted that it would have come to be? Did life happen to be or, given the conditions for it, did it have to be?

It is characteristic of the new physics to speak of the "mind of God". In most cases, I believe, this is taken to mean that ideal Platonic mathematical structure from which the shadow world we live in came to be. We would have a unified theory and thus an understanding of all physical laws and the initial conditions under which they work. Would we also fundamentally understand life? As I understand it there is no intentionality associated with the "mind of God" of the new physics. Can life be understood without that intentionality? These are, I accept, pretentious questions which go beyond what a scientist would usually accept as a rational approach to questions about the world in which we live. They lead me to address what still remains of the three concepts in the title of this paper, a new theology.

## *The Theology of Science.*

This new theology of which I speak is essentially what has been called by Michael Heller "the theology of science". Although it is admittedly a very summary statement, I think it fair to say that from Plato to Newton the contest as to what part mathematics has had in coming to a scientific understanding of the universe took place in a religious framework. After a period of what might be called "atheistic rationalism" we again hear the refrain of discovering "the mind of God" coming from scientists. The theology of science is proposed as a serious attempt to evaluate that long previous history and to make sense of its echo in our times. It is no longer sufficient to dismiss any possible conflict between science and faith as only apparent, since their distinct methods do not allow for conflict. As I hope I have indicated above, the methodology of modern science is evolving and that is why I call it a new physics. The suggestion here is that the methodology of theology must also be in flux. As an effort at coming to a rational understanding of revealed truth, theology is subject to all of the vagaries of human thought. And revealed truth, granted that it first occurred at a privileged time and to chosen persons, is continuous and incarnate. What is revealed is deeply imbedded in the way we think and the understanding of it is, therefore, evolving. Furthermore, all rational knowledge of God is analogous and it would, therefore, be appropriate that concepts from the new physics be taken as analogies in the search to understand God. The methods of theology have always been very determined by prevailing philosophies and Christian theology in particular has since the Middle Ages been very much attached to the Aristotelian-Thomistic tradition, and especially to the concept of final cause. Thus such notions as purpose and design have been dominant. Might the theology of science not apply itself to an attempt to understand God, the creator of a universe where purpose and design are not the only, nor even the dominant factors, but where spontaneity, indeterminacy (even at a macroscopic level) and unpredictability have contributed significantly to the evolution of a universe in which life has come to be.

The theology of science would, in both its methodology and in the matters for its reflections, be a complement to existing theological disciplines. In its methodology it would critically evaluate and embrace, according to that evaluation, the non-teleological approaches of the new physics. It would reflect upon the evolving universe, and in particular upon the evolution of life in that universe, as we know it from the new physics. In so doing I think theologians must beware of a serious temptation of the new physics. Within the culture of the new physics God is essentially, if not exclusively, seen

as an explanation and not as a person. God is the ideal mathematical structure, the theory of everything. God is Mind. It must remain a firm tenet of the reflecting theologian that God is more than that and that God's revelation of himself in time is more than a communication of information. Even if we discover "the mind of God" we will not have necessarily found God. The very nature of our emergence in an evolving universe and our inability to comprehend this even with the new physics may be an indication that in the universe God may be communicating much more than information to us. The theology of science might come to see the universe of the new physics as a unique revelation of God. There will, of course, always be a tension between science and theology because of the transcendental (beyond reason) character of the latter, but considering the somewhat Platonic quest for the "mind of God" in the new physics that very tension could be the source of a quite creative dialogue.

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