

# An Introduction to Neuroscience

## Contents

The Aim of the Essay and this Introduction .....	3
Validating the Proposal.....	5
Ontology.....	7
Neuroscience and Scientific Modelling.....	11
Neuroscience and Society .....	14
Epistemology.....	16
A New Taxonomy.....	20
The Driving Force .....	23
Creation and the Energy of Consciousness .....	26
The Mechanism of Creation.....	31
From Vibration to Rotation .....	35
The Metaparadigm .....	36
Neuroscience and Metascience .....	39
References .....	41



## AN INTRODUCTION TO NEOSCIENCE

Much of our current scientific thinking about microscopic physics and cosmology is probably wrong and will have to be discarded. Maybe in the future there will be a major revolution in physics that will revise our whole idea of reality. We may look back on our current attempt to understand the origin of the universe as hopelessly inadequate, like the attempt of mediaeval philosophers trying to understand the solar system before the revelations of Copernicus, Kepler, Galileo and Newton. What we now regard as ‘the origin of the universe’ may be the temporal threshold of worlds beyond our imagining.

Heinz Pagels

*Perfect Symmetry: The Search for the Beginning of Time*<sup>1</sup>

### **The Aim of the Essay and this Introduction**

*An Introduction to Neoscience* was written a year after the proposal for a new scientific paradigm appeared in “The Physics of Ultimate Reality”. This was a long essay in *Jehovah and Hyperspace: Exploring the Future of Science, Religion and Society* (New European Publications, 2002), which introduced the concept and the term neoscience and laid down its main principles. The present booklet is partly an overview of that essay and partly an extension of its theme, as well as an introduction to the concept of neoscience. Though a new scientific paradigm constitutes a vast enough challenge for any author, the original essay was part of an even greater challenge. It functioned as a keystone in the wider theme of the book, which was that at any given period of history religious and social structures are ultimately dependent on the world view provided by the science of the time. The total argument of the book which brought together science, religion and socio-economics thus constituted a metaparadigm, in effect putting forward a new understanding of what being human means.

This is not so radical an innovation as it may seem, for in a post-Darwinian and post-Hubble world we are for the first time in our history conscious of being an evolving species living in an evolving cosmos. Science is not excluded from this developmental process:

like everything else, it evolves and therefore the emergence of a new kind of science is to be expected. Today it is impossible to ask who we are or what is the meaning of existence without at the same time asking how our universe originated and where we, as a species, are going. We must see empirical science, like everything else, within the evolutionary flow, remembering that it began as an innovation in philosophy and a new way of learning about reality, specifically through the method of measurement, prediction, experiment and inductive logic. When a further evolutionary step is proposed, involving new principles and new ways of thinking, those scientists who know little of the history of science are likely to put up emotionally charged resistance, because they will be unprepared and will feel their ideal of truth threatened. Even those who are aware that paradigmatic changes in science have happened in the past may find their open-mindedness tested to the limit when a new step-change is proposed, for a genuine new paradigm demands a rewiring of important parts of the brain.

Although *Jehovah and Hyperspace* is a probing into the future at several critical points, where philosophical, theological, scientific and socio-economic themes meet and interact, *An Introduction to Neoscience* is to be read as a freestanding monograph and judged solely on its scientific value. At the same time, it must be said that it is a first step, very much work-in-progress, and thus at many points final judgement must be suspended until more evidence is in. It hardly need be said that any new paradigm takes a long time to develop, and when first proposed bears as much relationship to its final state as, say, the Wright brothers' first flying machine, which travelled two hundred yards and twenty feet off the ground, bears to Concorde. It might be noted in passing that the Wright brothers were not aeronautical engineers but bicycle mechanics. The potential of the present work will become clearer in a book now in preparation, to be entitled simply *Neoscience*, whose publication is planned for 2006. This will be the first volume in an intended trilogy, the other two titles being *Neotheology: Beyond Christianity* and *The Global Family: Beyond the Nation State*.

*An Introduction to Neoscience* can be read as an appendix to "The Physics of Ultimate Reality", but since it may be read first, it would be worthwhile to anticipate very briefly the central argument of that work to give a first orientation. There are several interlocking postulates to neoscience, but the most basic is that our three-dimensional world is a subspace of a timeless higher dimensioned reality. This is

the hyperspace from which our cosmos emerged at the Big Bang. That simple statement, though controversial when put so baldly, will suffice at least to indicate why we are dealing here with a new kind of science.

### **Validating the Proposal**

A scientific paradigm is ultimately validated by the new vision it opens up, by the coherence it gives to many formerly unconnected facts, by fitting in what previously had to be excluded as simply anomalies from the existing paradigm and by raising new questions and new kinds of question. At the beginning of the paradigm's construction one has only promise of systemic coherence to come, in effect little more than a feeling that this is the right direction in which progress can be made. Quite apart from the fact that its proofs are cumulative and mutually reinforcing, the paradigm rests upon foundational principles which must often be counter-intuitive. This radical break with the familiar is a defining mark of a genuine new paradigm, as against a major improvement of the old. When the new paradigm is well established, it will seem more rational than the old, but initially the basic principles of the new constitute little more than an act of faith.

To add to this inherent difficulty in paradigm creation, the foundational principles themselves will almost certainly be altered as their systemic consequences feed back. The classic instance of this process is Copernicus's theory of a sun-centred universe, which was theoretically flawed and astronomically useless until Kepler, using Brahe's data, showed that the planetary orbits were not circular but elliptical – a possibility which had simply not occurred either to Copernicus or any scientist of his generation. Not even the greatest and most imaginative of scientific minds had considered this possibility, and it was, ironically, most unwelcome to Kepler when forced upon him by the observational facts. Hubble too at first resisted the idea of an expanding universe to which his observational data led, and Planck similarly only accepted the illogical (or perhaps a-logical) assumption of an indivisible quantum of energy as a desperate last resort.

The last section of *The Physics of Ultimate Reality* was entitled "Come in, Kepler", to indicate the author's hunch that the theory as presented in its raw state called for a supporting principle of similar importance. This introduction contains several such principles, which have come into view since the essay was written. Two of them are of particular importance, since they not only give greater completeness to the theory but suggest *experimenta crucis* that will both confirm

it and provide answers to two of the most fundamental problems in science today. The first concerns the part that the energy of consciousness plays, or can play, as an explanatory principle in natural science. The second concerns the mechanism by which the force that drives the expansion of the cosmos is manifested as universal orbital movement, from electron to galaxy.

Difficult as the working out of a new paradigm may be, the problem of communicating it – thus making testing, correction and development possible - raises two further problems of a different kind. By the very fact that it is, by definition, revolutionary and radical, a new paradigm comes as a shock, which may have two contrary effects. It may, on the one hand, generate excitement in those who sense at an intuitive level that this is an escape from the limitations of the present, the way forward despite manifest gaps or, on the other hand, it may generate emotional resistance, sometimes violent, because it sets up cognitive dissonance, opposing a familiar present to an unknown, untested and rather alien future. The astronomer Cecilia Payne-Gaposchkin described in later years her reaction to hearing Eddington's impassioned description of Einstein's new theory of General Relativity as "a complete transformation of my world picture. My world had been so shaken that I experienced something very like a nervous breakdown." The history of major change in science often illustrates a blindness to unwelcome facts so insuperable as to constitute the psychological state to which Freud gave the term denial. Clearly, a paradigm claiming to offer a more complete view of reality itself will call forth the strongest emotional reactions, for it will impact disturbingly not only on orthodox science, but on philosophy and religion too.

The second problem in communicating a genuine new paradigm arises from the vastness of its scope, and the investment in time and hard thought which is necessary to assess its claims. The new view cannot be seen until the mountain has been climbed, but without initial proof that it will pay scientific dividends no one could be blamed for refusing to embark upon the time-consuming effort necessary to understand, let alone evaluate it. This is a Catch 22 that cannot be avoided and has been made worse by the fact that so many purported new paradigms in physics have appeared in the past thirty years (usually promoted as Grand Unified Theories) that one might talk of "paradigm fatigue". There is nothing initially to recommend the present proposal, other than the "hunch" that might come after a brief inspection of the prospectus.

## Ontology

The most obvious innovation in *Neoscience* lies in its basic conjecture that the three-dimensional domain of natural science, both classical and quantum, is, in fact, a limited part of a higher-dimensional reality. This is not, it should be emphasized, a version of the many universes idea first promoted by Hugh Everett, for all his conjectured universes are implicitly three dimensional, even if located in some ill-defined Platonic realm.

The initial conjecture of neoscience can be justified as a logical consequence of Hubble's Law, which may be simplified for immediate purposes as follows: the fact that the visible cosmos is expanding implies necessarily that the expansion began at some definable moment of time in the past. The word "moment" conceals a critical ambiguity, for it means strictly a timeless event of some kind, but science uses it with much the same looseness as in everyday speech, where it refers either to a very brief period or an event which happens too quickly for instruments to record. This confusion between strict definition and every day usage is at the very foundations of conventional physics, where key terms such as *mass*, *matter* and *particle* are often employed in a most naïve way. The wider problem is dealt with in the essay, but here attention will be concentrated on the fact that if the expansion of the cosmos is wound back, so to speak, on an imaginary film, it must logically have begun at Time Zero, with an energetic event that was a true dimensionless point, whereas physics in practice chooses to start at  $T = \text{Zero} + 10^{-43}$  seconds, so-called Planck time. There are several reasons for this choice, and not all theorists would reject the Time Zero option, but it is well recognized that current physics cannot explain or describe conditions during Planck time, let alone before it, and there is a widely held belief that if the cosmos were to be shrunk to a point, its energy content would, by the normal logic of mathematics, become infinite. Standard physical theory abhors infinities and zeros, and avoids them by a process of renormalisation which Richard Feynmann once described as "dippy", but, dippy or not, this mathematical sleight of hand, seems to work, so far as the aims of current particle theory are concerned, and hence there has been no great incentive among either physicists or cosmologists to venture into the theoretical minefield of infinities and infinitesimals which seem to open up by treating the naked singularity as a physical reality.

Nevertheless, the logic of an expanding universe which began as a dimensionless point of energy at Time Zero constantly reappears,

like Banquo's ghost, to spoil the theoretical feast. Small as the gap may be between the Planck dimension and Time Zero, it must be overcome, and the only two ways to do this are to state as an act of scientific faith that the universe began either with the Planck domain or as a true point of energy of uncertain location and uncertain cause. The choice will ultimately result in two kinds of science.

Neoscience chooses to start from Time Zero, and to approach the expanding cosmos as an adiabatic system of decreasing energy density. This simple principle of methodology has the immediate consequence of removing the dreaded infinity if the complementary assumption is made that the universe is bounded, and therefore finite. Following the first law of thermodynamics, the amount of energy of all kinds in the total cosmic system must be equal to that which is hypothesized to exist at the beginning in the "Ur-point". It may be immense but it is finite. The idea of the energy of the cosmos once contained in a point may seem at first absurd, though it is in principle no different from the point charge of energy which is accepted without question in physics, nor is it difficult to conceptualize as a location in space if we consider the notional centre point of a thin wire under tension. Just as we accept the notion of centre of gravity, it is perfectly reasonable to accept a metacentre in this imagined wire where all the tensive energy is located. When we know more about the energy content of the cosmos (and what we mean by energy in itself) it will be possible to calculate the totality of energy in the point of the Big Bang, or, as astronomers sometimes call it, the Big Flash.

This new and all-embracing constant must be as significant as Planck's quantum, and thus should have an identifying label. I will call it the *quantal*, its definition being *the amount of initial energy which undergoes transformation through cosmic expansion*. Assuming that the cosmos is a closed system, this must be the same as the energy content of the cosmos itself, since as the universe expands, no energy is lost or gained. Assuming a finite cosmos, and a fixed relationship between energy density and volume at any point in the expansion, it would appear that the quantal energy is related to the Planck Density of  $5 \times 10^{93}$  grams per cc., but better expressed as electromagnetic frequency than as weight per unit volume. While this constant obtains for any three dimensional cosmic space, it would seem to fail at the limits, that is, at the start, when the cosmos-to-be had zero size and at the end point of cosmic expansion. The essay deals briefly with the latter, identifying the apparent anomaly in the residual *Zitterbewegung*, the permanent jittering of the atom. The

amount of energy needed to still this motion, by cooling the cosmos still further, is so great that it constitutes a barrier between near absolute and perfect absolute zero temperature. A comparable barrier seems to exist at the Planck length, which seems to be defined as the indivisible lower limit of electromagnetic wavelength.

The paradox of the ultimate indivisible was at the heart of Zeno's paradox 2,500 years ago and Galileo's mathematical entities *quantum indivisibili* and can only be resolved, Planck-style, by simply defining it as the smallest possible amount, or that beyond which there is nothing smaller, only zero. The essay introduces an ontological principle of asymptosis, under the label of *Therp's Law*, which essentially states that there is an irreducible gap between something and nothing, and this may be called the *Therp Gap* for identification. Despite the fact that an indivisible gap even in mathematics appears to be not only counter-intuitive but counter-logical, science seems to be forced to invent this concept, as once it was forced to accept the illogicality of imaginary numbers and the Planck quantum on the logical grounds that they worked.

Postulating a fixed amount of systemic energy and a finite universe leads to other conclusions. It implies a static universe only during that timeless moment when the cosmos has reached its limit of expansion and before contraction begins. This state of affairs is no different in principle to what happens when a stone projected vertically upward reaches the limit of its travel for a moment at the point before gravity starts to overcome the projecting force. It comes about not because the cosmos is flat or curved but essentially because the cooling process has created gravitational masses, from galaxy to planet, which function like so many springs waiting (so to speak) to pull the cosmos back to its origins once the expansionary force has been expended. Thus the limit of the cosmos is definable as that state when the quantal energy has become so diluted that it cannot withstand the gravitational energy concentrated in all the matter of the universe. This is essentially the Big Crunch scenario, except that from the new perspective, the final state is quite clearly a return to the dimensionless point of energy, the Ur-point, with which it all started, not to the small but finite state of the Planck domain.

This is too simple a scenario, however, and must be qualified with the postulate of "mini-crunches" when black holes of critical mass have occurred during the expansionary period, their energy being returned to the expanding cosmic system as "white holes", to use John Gribbin's term. He explains a white hole thus: "Just as matter

can collapse into a black hole, so a singularity might pour matter outwards into our Universe in the cosmic gusher of the white hole.”<sup>2</sup> That such events do actually occur is evidenced from recent observation of quasars, which appear to be, in effect, mini Big Bangs that have emerged from the prior collapse of ancient galaxies to point size. This and new data provided by the Hubble telescope and the Wilkinson Microwave Anisotropy Probe (WMAP), strongly suggest that the cosmos has an inherent structure, almost of a cellular kind, which was there in embryonic state from the beginning, and thus revives theorizing along these lines such as Lemaitre’s primeval atomic seed, a theme which will be taken up below.

Assuming that there will be an ultimate collapse of the cosmos to the dimensionless point of energy with which it all began, it can be seen that such a point marks a bridge into the ontology of hyperspace and a break with Cartesian science, which deals only with three dimensional space and defines the proper subject matter of science in these terms. After the Big Crunch the energetic Ur-point cannot be located in the three-dimensional reality of commonsense, for that familiar world will have gone out of existence, and one must therefore ask where it could possibly exist. Because it is dimensionless, the original point-source (and terminal point-end of a contracting universe) could exist timelessly in any dimensional domain, and concurrently in all, just as the notional point centre of a mathematical sphere can be the apex point of an infinite number of cones.

Forced by the logic of cosmic expansion to assume a hyperpatial reality, we are going beyond natural science and the *res extensa* with which it is competent to deal. The change is of such fundamental importance that a new term to identify it is essential, and *neoscience* was invented for that purpose. Neoscience may be considered as the physics of the infinite and the timeless, but other unconventional principles begin to emerge as consequences of taking as a starting point the twin premises of hyperspatial reality and the origin of the cosmos in a true point. It would be equally appropriate to call it *the new philosophy*, in the same way that science as we know it was at first considered a philosophical revolution and called natural philosophy to distinguish it from the kind of “science” – i.e., knowledge – that was then the norm. Galileo identified the paradigmatic change which he was promoting as the “new kind of knowledge”, *nuova scienza*, thus distinguishing it from the old, which then became seen as protoscience. When neoscience is established, it will reposition conventional science in the same way, which will eventually come to be

seen as a temporary stage on the way to a higher kind of knowledge and a new kind of commonsense.

Neoscience will not be by any means a complete break with traditional science, for just as natural philosophy incorporated the principles of formal logic which were the core and basis of the old science (and later developed these principle in Boolean algebra) neoscience must incorporate the principles of measurement, experiment and inductive logic which were the innovations of the scientific method. It would be premature to ask for details of how neoscience will differ in method from conventional science, but it can at least be said that it will make more systematic use of the postulational method, the thought experiment and a more geometrical and topological mathematics. The first two are, interestingly, innovations which we associate with Einstein, but which he could never fully exploit because his questionable use of time as a fourth dimension and his approach to cosmology through the field model which – like any model - imposed particular restrictions on his vision. As quantum science must be less empirical than classical science, so too neoscience must go further away from the seeing-is-believing principle of early empirical science.

### **Neoscience and Scientific Modelling**

The method of neoscience is necessarily postulational, since it must start with unproven guesses and follow through their consequences until they result in verifiable experimental conclusions and/or increased systemic coherence. On the other hand, neoscience will be much more visual than current quantum science, avoiding the temptation to use the mathematical model for its own sake. Even when the information sought and gained is mathematical, the tendency of neoscience will be to convey it by graphs and vectors, rather than by equations and matrices. The need to know *as far as possible* what physical entities look like at quantum level has been almost entirely suppressed in modern physical theory, which takes the shape of the equation as the most meaningful representation of reality. Galileo's principle that mathematics is the language of science, dramatically confirmed by Newton, and later by Dirac, still holds true, but the questions now arising are, what kind of mathematics and what form? Two undesirable consequences which have followed from assuming uncritically that the differential equation is the ideal model are now coming into view. Firstly, the intrinsic interest of physics – microphysics at least - has shifted from the physical to the mathematical and, secondly, transformations of algebraic shape under mathematical operations

have been assumed too easily to represent reality itself. Both trends are exemplified in string theory which, it is widely recognized, has taken physics, and indeed science more generally, to a crisis point because it is *in principle* not subject to experimental proof.

There will doubtless be unease at a proposal to emphasize the graphic and pictorial in science, especially since there is a widespread feeling that visualization is a requirement of classical, rather than quantum, physics, and thus the proposal will seem at first like a retrograde step. There are, however, signs that the “over-mathing” of science, and particularly of the so called “soft sciences” now calls for examination. If the path of the photon in motion, which is at the heart of neoscience describes a real shape in 3-space, even though below the threshold of perception, there is *prima facie* reason not to exclude from physics the search for such shapes. It is interesting that Gauss, arguably the finest mathematician since Newton, seemed to have glimpsed science moving away from numerical and algebraic models towards dynamic geometry, for he wrote, “Perhaps in another life we will be able to attain insight into the nature of space which is now unattainable. Until then we must place geometry not in the same class with arithmetic, which is purely *a priori*, but with mechanics.”<sup>3</sup> Neoscience offers in this life the same deep satisfaction as Newtonian mechanics but based on the motion of point particles and waves in two and three dimensions.

The role of modelling in scientific theory is a philosophical problem of the first order, deserving a whole book to itself, and in the past twenty years or so developments in topos and conceptual mathematics have started to open up a new understanding of mathematics which may prove to be as revolutionary as non-Euclidean geometry and Cantor’s mathematics of the infinite. So it is perfectly possible that a natural model for a hyperspatial reality, and other aspects of neoscience, exists already potentially, just as Minkowski’s four-dimensional geometry awaited Einstein’s General Relativity. Whether or not this may prove to be the case, neoscience may be seen as an extension of the debate about the role of mathematics which has exercised chemistry for half a century, ever since the discovery of valence bonding and resonance and the emergence of quantum chemistry as a semi-autonomous discipline. The natural desire of quantum chemistry was to use the wave equation and other basic devices of physics, thus putting it in conflict with traditional modelling procedures, which relied heavily on two and three-dimensional

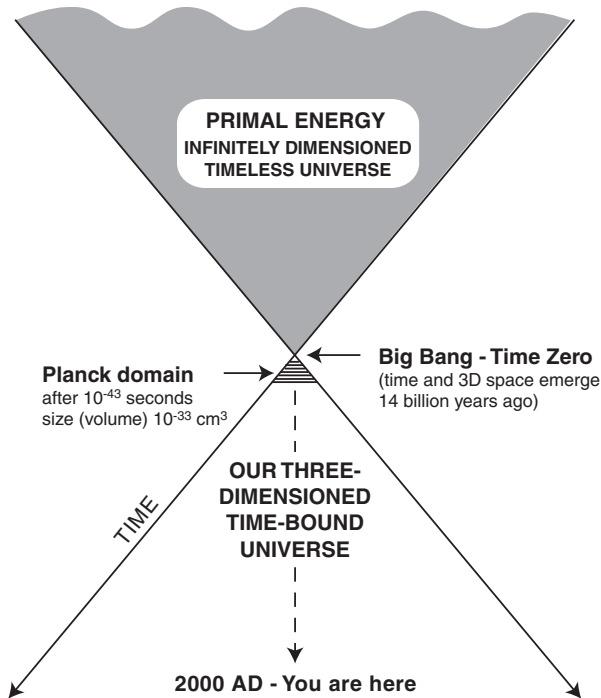
models that displayed the bonding relationships as visible struts and spars in a scaffolding of molecules.

An admirable analysis and overview of the crisis in chemistry is to be found in the compilation *Chemical Sciences in the 20<sup>th</sup> Century* and the epigram from one contribution will highlight the current crisis in physics:

*Contrary to what is sometimes supposed, the theoretical chemist is not a mathematician, thinking mathematically, but a chemist, thinking chemically.*<sup>4</sup>

The same argument is implicit in neoscience - if for “chemist” we substitute “physicist”. Physics at the frontier may, in fact, have other things to learn from the procedures of chemistry, as for instance the use of the arrow of the chemical transformation where time is an implicit quantity and when it is more appropriate than the static equality sign of the physicist’s equation. One may say this with some confidence, for transformation of energy in time is at the heart of neoscience. It may be too soon to make predictions, but it is certainly possible that neoscience will develop its own hybrid variation of Feynman diagrams to express the transformation events that happen not only through impact of particles but through changes in ambient energy density.

The following diagram may help in grasping the central concept of neoscience. It displays the fact that our three-dimensional cosmos had its origin at the point of the Big Bang, and has been expanding for some fourteen billion years. Since we may assume that time itself came into existence at the same point, our cosmos has its origin in a timeless realm (shaded) of higher dimensions. While it would be logical nonsense therefore to talk of what existed “before the Big Bang”, the phrase may be used loosely to indicate that there was a prior cause of some kind. This may not be strictly the ultimate reality, but it is a greater reality - at least, less dimensionally restricted - than the familiar universe which until now has been the proper subject matter of science.



*Fig 1. The emergence into time of our 3D cosmos*

### **Neoscience and Society**

Neoscience will bring new light to bear on the whole question of empirical philosophy, seeking to retain that absolutely essential factor of visibly demonstrable fact, and thus public and undeniable truth, which is the ideal of science. Science is a truth system, no less than religion, and is a civilizing force for this reason. Its ideal is the search for a truth that is intellectually compelling and which therefore, through a process of agreement by logical and experimental persuasion, plays a binding role in building up a community. This tacit search for a higher kind of human community constitutes the moral backbone of neoscience, as it has been for science and for protoscience before it. Protoscience is often ridiculed, with the “angels on a pinpoint” kind of debate often cited as a reason, but this is to overlook the compelling force of its methodology, the logical syllogism. Before science proper appeared, logical debate had generated a kind of

intellectual intoxication in the early Middle Ages precisely because it seemed to lead to certain and open truth, as against emotional and partisan opinion, which have a divisive effect, and private theory, which remains no more than idiosyncrasy until it is put into testable form. It is worth emphasizing that the same irrational forces against which protoscience contended still oppose science today and will oppose neoscience. The pseudosciences of alchemy and astrology along with other kinds of secret, cabbalistic or gnostic knowledge, which do not seek public and demonstrable truth, still exercise great influence in human affairs.

Early science was passionately empirical, famously exemplified by Galileo's abortive attempts to persuade his inquisitors to look through the telescope and see the new universe, but later developments have increasingly weakened the force of naïve empiricism. We can, for instance, never see directly the elementary particles of matter, and their existence can only be inferred by the tracks they leave in cloud chambers. The discovery of non-Euclidean geometry has taken physics more deeply into the non-visualizable, as has string theory, with its multi-dimensional particles, and neoscience adds weight to the need for a new understanding of the limits of empirical science. This is a crisis which has been building up for nearly two centuries, since Dalton's atomic theory, and was recognized nearly eighty years ago in Reichenbach's classic work, *The Philosophy of Space and Time*. The sections of his book entitled "The limits of visualisation" and "Visualisation of non-Euclidean geometry" are almost summary statements of the need for new philosophical foundations on which to build a more comprehensive science. In the end, though, the critical issue will be seen as an act of faith, whether or not hyperspace is real and, if so, what kind of reality it represents. There can hardly be doubt that a science which deals with a postulated hyperspace existing in some prior but timeless way is fundamentally different from science as we have known it for four centuries. Neoscience is, paradoxically, the science of both time and timelessness.

Eventually it will change society as comprehensively as classical science has done, and as protoscience did before it. Protoscience, essentially comprised of formal logic and naïve observation but little mathematics or instrumentation, created the culture of the European Middle Ages. This in turn gave birth to classical science, which has transformed the face of the earth, lifted millions out of poverty, but now through technology threatens to lay waste our planet. Neoscience is not likely to add greatly, if at all, to technology, and because science

and technology have become so closely related it needs perhaps to be emphasized that science is not the handmaid of technology but primarily and essentially a mode of understanding and of truth seeking. Just as it may be said that a prescientific culture is at a lower evolutionary level than a scientifically mature culture, a neoscientific culture of the future will be validated as it is seen to be a more advanced truth system than the science which has become the basis of Western civilization. The “rightness” of neuroscience will be shown, or not shown, in its superiority to traditional science, if “superiority” is taken to be an almost spatial metaphor, indicating a higher perspective from which one may have a more expansive view of reality.

There can hardly be doubt that a science which deals with a postulated hyperspace existing in some prior but timeless way beyond sense experience (one presumes) is fundamentally different from science as we have known it for four centuries. Neuroscience is, paradoxically, the science of both time and timelessness. Eventually it will change society, just as classical science ushered in the industrial revolution and the Enlightenment, not to mention mechanized wars of mass destruction and nuclear obliteration. It is far too early yet to anticipate the detailed effects of neuroscience, but the fact that it is inseparably linked with theology, and thus ultimately with a new religious vision of global significance, may be taken as reason for optimism.

### **Epistemology**

The epistemological foundations of neuroscience exist at this point only in part. Certain principles which run counter to commonsense and contemporary science must be accepted because they have been experimentally demonstrated, in physics and psychology, and four of them will be looked at briefly here.

- (1) As a consequence of Special Relativity, indeed of the simple fact that light propagates at a finite speed, we can deduce that all observation, scientific or otherwise, is of the past, since the observer sees only light reflected from the object under scrutiny, light which has taken a measurable time to reach the observer's eye and create visual awareness. The philosophical consequences of this fact are radical, but for most scientific purposes are of no consequence. The exception to this is, of course, in cosmology, where astronomers must take into account that when they observe an object that is many light years away, they are seeing something which may possibly no longer exist, since some stellar

objects will have exploded and dissipated long before the light from them reaches earth. The same logic, however, applies to anything which is observed, as for instance when I observe the vase across the room, I am looking at something which, in that state, has passed out of existence – albeit only a billionth of a second ago. The epistemological consequences of this physical fact are not always obvious but one of them is that each individual exists in a present time specific to his or her consciousness. Strange as it may seem, we each see a different vase – or at least the same vase at a different time – across the room. To call it the same vase is a convention akin to that by which I assume the same identity to someone at the age of one day or eighty years, or to an acorn and an oak.

The consequences for science may be exemplified in a simple thought experiment, imagining an intelligent being in a distant galaxy who sends a space ship off to our earth. Its decision was made perhaps a billion years ago, when calculated in earth time – that is, a billion years before I was born, and this leads to the question, which is the actual or real time? Its present, when the decision was made, is my future, for the decision happened a billion years before my present came into existence. There are well-known philosophical problems involved in this paradox, first formulated by Bishop Berkeley in the 18th century and re-appearing in relativity and quantum theory but, relevant as they are, they will be sidestepped here to make two fundamental points. Firstly, normal science cannot function without assuming an ideal present as an absolute frame of reference, astronomy in effect assuming that the true present is an “earth-present”, which in turn is a composite of the “individual presents” of all the inhabitants of the earth. If an absolute present be postulated, we seem to be forced to postulate also an absolute observer – that is an observing consciousness that is hard to distinguish from the traditional God of Western religion.<sup>5</sup> Combine this with the speculation that the Big Bang had a prior cause, and an uncomfortable interface between science and theology begins to appear – uncomfortable for scientists because science by definition excludes “occult” causes and for religionists because a new kind of creation story is now seen to emerge from science to challenge those which mainstream religions have inherited from a prescientific age. If set against the ancient mythologies, the new creation story has the

great advantage of being logical and scientific, thus more “real” and universally valid than any mythical account of creation.

- (2) The fact that awareness of dimensionality is not a direct perception but a learned experience and a mental creation, was not known when science came into being, but its epistemological consequences must now be taken into consideration. We only see directly a two-dimensional representation of reality, the retina of the eye acting in effect as a flat screen receiving radar signals, and our unquestioned sense of a three-dimensional reality comes, in fact, from an ongoing process of adjustment to this information, in which it is modified from memory and from visual cues such as shadows and highlights to create 3D awareness. Since we learn to see the third dimension of reality by extrapolation from immediate sense data, it is plausible that awareness of higher than three dimensions may also be attained by extrapolation. We already perform this process successfully and without thinking when we “see” a cube represented by a two-dimensional drawing on the page. There are very dramatic proofs that 3D awareness is a learned process contained in accounts of individuals who were born blind but have had their sight restored surgically in later life. At first they see not our familiar three-dimensional world, but only a two-dimensional jumble of shapes and colours, and the process of learning to interpret them is long and difficult. In fact, they feel such discomfort when confronted with the confusion of uninterpreted visual sensation that they will often express a wish to be blind again. By contrast, some individuals have a highly developed dimensional sense. Mathematicians acquire it by constant manipulation of mental and symbolic models, but at a more everyday level architects and engineers must develop an exceptional three-dimensional awareness in order to interpret two-dimensional drawings as the higher dimensioned reality which they, so to speak, compress and encode. Even bus drivers develop a more extended sense of dimensionality than the average person, at least insofar as they must be habitually aware of the extension of their vehicle, if they are not to scatter the walkers on the pavement as they turn a corner or slice off the roof of the bus with a low bridge. Some extension of ordinary three-dimensional consciousness is therefore certainly possible, but it is not clear at this point what would be needed in order to live habitually in awareness that we exist within a higher dimensioned reality than

the familiar 3D world of our senses, somewhat as salt dissolved in water may be said to exist within brine.

- (3) A fully up to date science must now also take into account the fairly recent awareness that what we call “reality” is only a very restricted part of something greater that our sense organs are too limited to register. It is well known, for instance, that our eyes are blind to any light frequencies that are not in the so-called visible spectrum, whereas some night-hunting animals can see in the infra-red region and, similarly, many animals can hear sounds which are inaudible to the human ear. Some forty years ago a now classical paper on perceptual psychology, “What the Frog’s Eye Tells the Frog’s Brain”, raised the question of what constitutes reality in itself by demonstrating the very different reality accessed by the frog’s consciousness.<sup>6</sup> The authors showed experimentally how the frog’s visual cortex receives a picture of the world outside as little more than a series of vertical stripes, and when something small and insect-like moves across it, its tongue is triggered to flick out and catch it. This is reality for the frog, and in considering the frog’s limitations we are forced to acknowledge that what humans call “reality” is, and can only be, what the human senses and brain mechanism are capable of putting together for human purposes. We know now, for instance, of the existence of the Casimir force filling apparently empty space and making it, in fact, a plenum of electromagnetic radiation. One does not even need this knowledge to be aware that the same empty space contains “silent” radio waves that can be accessed by tuning in a radio. The overall point being made here is simply that being unable to see or experience higher dimensions directly is not proof that they do not exist. If this were the case, science would never have come to accept the real existence of atoms, and indeed eminent scientists, such as Mach and the Nobel Laureate Ostwald, argued up to the early 1900’s that science should reject them as mathematical fictions.
- (4) The most radical epistemological shift which calls for a new science comes from new understanding of the subject-object relationship which underpins the very concept of science. Slowly we are coming to see that scientific objectivity is an epistemological short cut, an ideal to be sought but never attained, but a belief so deep-rooted that its significance is often overlooked, even though

it raises procedural problems at critical points in more than one science. Modern cosmology, for instance, is totally dependent on the objective reality of the redshift, but we know from the findings of perceptual psychology that redness is a conscious and subjective response to the frequency of electromagnetic waves in the visible spectrum. Indeed, in some types of colour blindness what the majority of people would experience as red is experienced as green. The problem cannot be evaded by arguing that my sense of redness, or any other colour, is merely a subjective decoding of the objective fact which is in the wave frequency, for redness, in astrophysical terms, is what I experience when the light source is moving away from me, not from anyone else. Without an observing “me”, there is no colour, just as without a hearing me there is no sound, merely acoustic frequencies. The conclusion which must be drawn from these findings of perceptual psychology is that we cannot have an objective science of cosmology unless we accord an objective reality to “redness” which is false to the epistemological facts.

The wider conclusion to be drawn from these four issues is that the conventional concept of science as objective and certain truth must be radically modified. At the very least, scientific objectivity must now be seen as a functional simplification and certainly not as an absolute law or principle. This new epistemology of qualified objectivity is ambiguously stated in Heisenberg’s Principle of Indeterminacy, which states that it is impossible to know with complete accuracy both the position and momentum of a particle. The fact that this uncertainty can be formulated mathematically leads to the illusory conclusion that it is within the particle event, rather than the mind of the observer. Although Heisenberg’s principle actually says, “That’s all we can know about quantum reality,” it is usually mistakenly interpreted to mean, “That’s the way quantum reality actually is.”

### **A New Taxonomy**

A major difficulty in physical science today arises from the lack of a sound taxonomy. Every taxonomy is based on a criterion which is chosen for its significance, and if this is not logical or proves to be undevelopable, the science itself becomes distorted as new information comes in. A biologist, for instance, who divided the animal kingdom into spotted, striped or plain coloured would never discover anything of value in a general sense, though he or she might come

up with many interesting facts. In a biological science based on these categories, one of the most significant “discoveries” would be that zebras, wasps and tigers were the same kind of creature.

The problem with physics is that it continues to use terms, and thus categories, from a prescientific age which carry over vague but powerful assumptions that inhibit deeper insight. By way of comparison, most of the world’s languages have inherited a world view in which sex was felt to be the most significant aspect, and these are now fossilized in the male and female genders of nouns. In a similar way physics has inherited the division of reality into solid, liquid and gas, and has had to fit newly discovered states, such as plasma, liquid crystal and radiation, into these three mental pigeon holes. Particles are usually assumed to be solid, in that they move through space and have mass, but short-lived particles are often called resonances, which is presumably meant to indicate their lack of solidity. The particle taxonomy which underlies physics has emerged *ad hoc* over a century or more, and the discovery in accelerators of hundreds of new particles with different spin, charge, mass and lifetime has resulted in a taxonomic crisis that is rarely acknowledged. They must surely have some overarching common property which would highlight their significant differences, but what?

Modern biology has encountered a somewhat similar crisis in taxonomy with the rise of evolutionary genetics and molecular biology, when a new system, cladistics, based on time and gene related criteria, was invented to handle new data or, rather, the perception of a new criterion of significance, namely the sequencing of evolutionary descent. In some instances the new taxonomy clashes with the classical Linnaean system, based essentially on similarity of shape, but in general they work in a complementary way, with the old system used to show a static relationship in terms of genus and species, and the new system used to show evolutionary branching from a common ancestor. A cladistic arrangement will show, for instance, whether or not humans, gorillas and orang utans are descended from chimpanzees or whether all are collateral branches in a common ape phylum. The taxonomic crisis in physics is similar to the biological problem, and has become acute only since Hubble’s Law forced upon science an awareness that physics now concerns energy in evolution, rather than the description of moving bodies, as it was in Newton’s time. Cosmology, astronomy, astrophysics and particle physics are now inseparably connected parts of the history of the universe.

*Neoscience* makes a start on the taxonomic problem, which rami-fies into unexpected places. It links up, for instance, with the need for a new system of units of measurement, based on natural constants, to replace (or perhaps complement) the International System. The main contribution which “The Physics of Ultimate Reality” made was to put forward evidence in support of three families of particle, the *photon*, *protoid* and *electroid*, as overarching categories which will subsume and make sense of the hundreds of newly discovered items in the “particle zoo”. It is possible that the neutrino may turn out to be a fourth category, and the value of this taxonomic “reality filter” will be proved by new insight into the neutrino’s structure, as well as other unresolved problems such as why the proton is (apparently) stable but the neutron decays in 886 seconds or, more generally, why any particle decays in a particular time period. At the heart of the proposed taxonomy is the postulate that the photon is a dimension-less unit of energy, propagating in a wavelike way, thus opening up a resolution to the nagging question of how light can be both wave and particle.

The new taxonomy will shift the descriptive emphasis in particle physics from algebraic to geometrical form, as already noted, and demand more systematic use of the thought experiment. Where particle theory tends now to ask, “What logical consequences follow from performing transformations on the algebraic model?” neo-science will tend to ask questions such as, “How would this or that entity appear at the limit?” or “What distortion in the shape of the particle would occur under this or that condition?” As an example of the latter question, one may consider the shape of the electron moving at relativistic speeds, which is shown to be a flattening along the axis of travel that would at the limit transform the electron into a two-dimensional particle. Thus the creation of three-space is shown to be related to the speed of light. Beyond the barrier of the speed of light we enter into a two-dimensional reality, but the energy required to cross it is immense.

Not all physical data can be visualized, of course, but where this is possible, they not only add to our knowledge of the physical world but have the enormous advantage of bringing the fundamental issues within reach of many more people. Mathematics will always remain the language of science, but it is not a healthy state of affairs when great discoveries in physics remain the secrets of a narrow group of specialists who have mastered increasingly narrow fields of mathematics in ever greater depth. When physicists themselves cannot explain their

findings to other physicists who are experts in a different mathematical dialect, it is surely time to take stock of the whole field.

### The Driving Force

Four unanswered questions lie at the heart of physical science today:

(1) **How, if at all, can physics go beyond the “Planck wall”?**

The answer is already suggested by the hypothesized existence of hyperspace, where our cosmos had its origin as an energetic point, but proof of the hypothesis will first demand resolution of a deeper metascientific question, namely what constitutes “proof” and “certainty”. In protoscience, proof was by the logical consistency of the syllogism. This method, once agreed, gave certainty which, if not as absolute as  $2 + 2 = 4$ , was effectively beyond question. The inductive logic of classical science, which finds the truth by generalizing from many examples and from experimental testing, is less certain, but is an essential method because to be genuinely scientific a statement must be vulnerable to disproof. Quantum science has moved away from this standard of proof, because truth is held to be statistical and probabilistic, with the result that certainty is sought rather through mathematical consistency than measurement *per se*.

In the matter of proof and certainty Neuroscience breaks new metascientific ground in two ways (at least), and their legitimacy will call for extended discussion at a philosophical level before agreement is reached among the scientific community. The neo-scientific method is critically dependent on the systematic use of the thought experiment, which until now has been regarded as a useful but somewhat suspect tool, using imagination rather as a crutch. It was Einstein who was credited with introducing the thought experiment into physics by imagining what he would see around him if he were (*per impossibile*) to travel along in a cloud of photons at their speed, and while other scientists have doubtless used their imagination in many ways, Einstein’s initiative has become the classical example. No more need be said at this point than to draw attention to the obvious, that since physics cannot go physically into hyperspace, or into the Planck domain, all that can be done is to guess what one would find there, and work out the consequences that would follow from formulating one’s guesses in algebraic or geometrical form. Beyond this procedural step, lies

the less easily defined method of proof by systemic coherence. That is to say, having fixed upon some plausible consequence of a particular thought experiment, one must gauge how far it fits in with all the other consequences and illuminates them. To simplify a vast and fascinating topic, it might be said that the method of neoscience will turn out to be more in the nature of forensic proof, in that each item of evidence presented to a jury must be fitted in with every other item, many of them different in kind, such as direct evidence, simple inference and circumstantial evidence. In the end the verdict on balance of probabilities may be very different from the kind of proof that comes from either simple logic or conclusive experiment.

**(2) What causes the cosmos to expand?**

The force which drives cosmic expansion may be approached initially as the counterpart to the resistive force (or inertia) which is assumed by Newton's second law. Resistance comes from the requirement of energy to transform 2-space to 3-space, just as any phase transition requires energy. The latent energy of water, for instance, acts as a barrier in making the transition from water to ice, and vice versa. Latent energy could, in fact, be appropriately called "barrier energy", as part of a new taxonomy of energy which will be required by neoscience and on which "The Physics of Ultimate Reality" made a tentative start.

From this perspective, the primeval quantal of energy will continue to generate 3D space from the point of the Big Bang up to a limiting size, when the electromagnetic "content" of the cosmos has become too diffuse to overcome the force which resists the "stretching" of 2-space to 3-space. The concept itself is simple, and its mathematization if probably just as simple. The dominant image in viewing the cosmos as an adiabatic system - i.e., as energy diffusion in an expanding system - is as simple as that of steam cooling in an engine as it pushes the piston. At some point the energy of the steam will be insufficient to overcome the resistance of the piston, and this marks the limit of expansion. The main difference between the energy in the steam cylinder and the energy within the cosmos is that the latter is in electromagnetic form, and it is reasonable to suppose that the Casimir force at every stage of cosmic expansion represents the state of dilution of this energy.

From this perspective the quantal of energy which is diffused by expansion can be seen as a single Fourier which is continually dividing into longer wave forms up to a limiting frequency, though this simple view will doubtless call for elaboration as its implications become more apparent. We must not forget, for instance, that Fourier analysis is invariably assumed to be of two-dimensional waves, whereas a vibratile cosmos must contain 3D waves, in effect pulses. Because the notion of the energetic quantal is so important, the initial assumption of neoscience should be emphasized, that the amount of systemic energy in the cosmos is finite and constant, from the beginning to the end of its expansion and deflation phase, from Big Bang to Big Crunch. The principle needs to be stressed because it conflicts with the general belief that if naked singularities exist, they must contain (or locate) an infinity of energy. This was the conclusion reached by Roger Penrose following the logic of General Relativity, and if his conclusion is wrong, there is reason to question the usefulness of General Relativity, and perhaps field theory more generally, as the most appropriate model of a dynamic cosmos. The term “dynamic” implies not only a cosmos that is expanding and then contracting back to its origin but, as will be explained below, a cosmos which grows to a calculable limit through a repeated process of expansion, partial contraction and further explosive expansion.

**(3) What gives rotational movement from proton to galaxy?**

As regards the cause of rotational movement within the cosmos, neoscience must go beyond the simple concept of a universe of homogeneous energy that is explosive and expansionary, for this electromagnetic energy “congeals” to form solid matter and it manifests as rotational movement at every systemic level, from electron to galaxy and (as Goedel and others have calculated) even at the level of the cosmos itself. The nub of the problem is that current theory assumes that matter at planetary and galactic levels came into existence as dust clouds contracted under the influence of particle gravity, but this offers no explanation at all as to why the components thus formed should spin or rotate. The question is one of the most fascinating in physics, and more will be said below in the section “The Mechanics of Creation” about the macro-force of dimensional pulsing. At this point, and without further elaboration, it may be said that the residual jitter of particles at near absolute zero temperature (the *Zitterbewegung*)

looks as though it may be the same pulsing on the microscale, in effect a barrier of resistance that stops our cosmos from being snuffed out. Some physical theorists seem to be already close to this conclusion.<sup>7</sup>

#### (4) **What force caused the Big Bang?**

This is really a two part question, for it concerns both the origin of the energy which was to create the cosmos and the nature of the trigger energy that set the event off. The first question is considered unanswerable by science, the second has been answered by Stephen Hawking with an explanation, acceptable to most theorists, that it all started in the Planck era with an initial “quantum fluctuation” in some kind of pre-existing domain of energy whose nature and origin are deliberately left vague. Hawking’s quantum fluctuations really have done no more than put the question on hold, for it is obvious that if the origin of the cosmos was a timeless point, rather than the small but finite area of the Planck domain, the random and uncaused fluctuation theory is now irrelevant. The simple reason for this is that fluctuation can only happen in time. An instability of some kind must, nevertheless, be responsible for the Big Bang, but of what kind?

The interconnection between the four questions just raised is the strongest possible evidence that a new scientific paradigm is now required. This introduction will conclude by offering brief answers, ranging from the conjectural to suggested experiments that will clinch the most critical principles of the proposed new paradigm.

#### **Creation and the Energy of Consciousness**

Of all the undefined terms in science *energy* is surely the most fundamental. For practical purposes it is defined as the ability to do work – as a glance at any scientific dictionary will confirm – and it can be expressed in many ways, such as kinetic, chemical, electromagnetic and gravitational. Potential energy is the odd one out, being an aspect of position in a gravitational field, but is somehow shoehorned into this ad hoc taxonomy. All of these (and potential energy with some juggling) can be transformed into each other, but what is the entity that undergoes transformation, and can there be such an entity as timeless energy?

As Sherlock Holmes remarked, when the impossible has been excluded as an explanation, one must accept the improbable, and in the

case of what triggered the Big Bang, if the impossibility of a random fluctuation in a timeless realm is accepted, some other energetic cause must be postulated. That will, of course, leave open the question of what caused the cause, but the responsibility of science in general, and evolutionary cosmology in particular, is only the obligation to push back the causal factor in cosmic evolution as far as possible. We have done marvellously well to have taken it back as far as the Big Bang, and should not be surprised if the next step proves to be difficult and controversial.

By its Cartesian principles science as currently defined excludes one form of energy, namely that of consciousness, for whatever the energy of consciousness may be, it does not seem to fall into the set of *res extensa* - three-dimensional objects - which is the proper and exclusive subject matter of science. It is definitely *res cogitans* - thinking stuff. On matters regarding conscious energy classical science, including Newtonian and quantum science, has nothing to say. It is not surprising, then, that any causal explanation for the emergence of the cosmos which postulates an act of will is never given a hearing, for not only would such an explanation be hardly distinguishable from what scientists rightly dismiss as “the god of the gaps”, but it would appear to result in a retrograde pseudoscience, which every scientist would rightly resist. The great ethical principle of science is that it is a truth system which excludes the occult, especially speculations about any power referred to as divine, and to keep science as a god-free zone is a noble endeavour. Yet equally noble is the scientific discipline of “letting a beautiful theory be killed by an ugly fact”, which T. H. Huxley, the originator of the phrase, actually called “the great tragedy of science.” The ugly fact here is that consciousness is now known to be a form of energy and thus cannot be excluded from science on principle, as it has been since the time of Descartes. To include it may call for a radically new kind of science, but that, surely, is what is implied by the term “new paradigm”. The reason for including consciousness within physical science is that just as reality which is solid to our senses has been found to reduce to electromagnetism – which Galileo, Newton and Descartes could never have suspected – consciousness too has been found to be inseparably linked to electromagnetic energy.

The connection between my consciousness (compounded of emotion, sensory perception, memory, desire, mood, etc.) and so-called brain waves is ambiguous. The brain seems to act as a generator, transmitter and receiver of the electromagnetic activity associated

with consciousness. Awake or asleep, this activity continues, and when it ceases, I cease to exist as a living organism. It is not inherently impossible that electromagnetic energy can be transformed into consciousness *per se*, just as it can be transformed into heat energy. Some process of energy transformation from food to consciousness seems to be undeniable, since the active brain uses up between 30% and 40% of the calorific intake of the body. Is this process reversible? That is to say, could the energy of consciousness be transformed into a kind of radiation that in turn was transformable into matter? There is some reason to think that this may be theoretically so, but a more fruitful line of enquiry may be to approach the transmission of consciousness as an example of energy transference through tuned circuits. At its simplest, one may think of such transference in the case of harmonic resonance, as, for instance, a vibrating tuning fork placed within a piano will set off vibrations in the strings tuned to the pitch of the appropriate harmonics. In the same way, brain scanners have shown the transmission of consciousness (especially of pain) between individuals in a close emotional relationship, and this suggests strongly that the Casimir plenum may be the medium of transmission, just as air molecules are the medium in the case of acoustic transmission. In conjunction with such well attested phenomena as the Schumann resonance in the ionosphere, this would suggest further that our immediate universe (perhaps the galaxy) may function as a resonant cavity and that the whole, still expanding cosmos may be a complex of such cavities. Confirmation of this hypothesis would present a major challenge to physical science. The question at issue here, however, is whether or not a conscious act could have triggered a physical process by creating instability in the initial equilibrium state, such as existed, one assumes, at the Big Bang point before expansion started.

A growing number of mainline scientists are concerning themselves with the interface between consciousness, energy and biological systems, too many to list here, but Herbert Froehlich, Fritz Popp, Mae Wan Ho, Roger Penrose and Michael Persinger call for mention. One who has gone boldly to the interface of consciousness and mechanical systems is Robert Jahn,<sup>9</sup> and his research findings prove beyond reasonable doubt that it is possible to affect random number generation in an electromechanical device by focusing attention and willing the machine to deviate. The deviations are small but mathematically significant and replicable, though not deterministically. The results from this and other experiments are at least circumstantial support for

speculating that the first cause of the universe, or at least the trigger which set off the expansion, is explainable in principle as the energy produced through an act of will. This should not be surprising, for all our bodily movements are initiated by acts of will, though not all at the same level of conscious decision. Bodily functions on the whole arise from the autonomic system, which is usually completely unconscious; I am often not conscious of making a decision, such as changing gear while driving, but in many instances I am intensely aware of exercising my will, as is evidenced by a furrowed brow or clenched fist. Thus, to take the last example, the train of electro-chemical events which leads to my lifting a heavy weight obviously begins with an act of will or intention on my part. This seems to be something different from creative intention, when, for instance, I will to paint a picture, but the difference is not important here. What is important is that if directed human consciousness can set things in motion, the question of what produced the Big Bang and its consequences cannot rule out an answer in terms of the energy of will, however unhappy physical theory, at this stage of its evolution, may be with such an answer. What kind of will and for what purpose are not questions for science or neuroscience but, once raised, they will not go away.

As regards creative energy, research into pattern formation by acoustic vibration gives support to the thesis that there is at least some element of consciousness at work in the universe, even though the main mechanisms of evolution remain, to use Jacques Monod's memorable phrase, "chance and necessity". Intelligent design, or ID, as it is commonly abbreviated, is an explosive issue in biology, and likely to end in professional suicide for anyone who seeks to analyse the evidence, for if ID could be shown to be at work in even the slightest respect, it would call for a radical adjustment to the neo-Darwinian paradigm which, in its most deterministic form, has the status of unquestionable dogma. That so-called "creation science", which denies biological evolution altogether, is put forward by religious fundamentalists as a counter-dogma to neo-Darwinism has left no room in the middle for those who simply want to look at the evidence. This unhappy situation is compounded by Darwinian fundamentalists, who dismiss any facts which might possibly indicate purpose in evolution as merely "apparent evidence", thus pre-empting any answer other than their own. Pattern formation in itself has no necessary connection with consciousness studies, and certainly not with religion, but the fact that it can be done through adjustment to the parameters of a vibrating medium has been cause for thought

since Ernst Chladni's experiments nearly two centuries ago.<sup>9</sup> More recently, Hans Jenny has shown how the energy of acoustic vibration applied to liquids and fine powders can produce an astonishing variety of shapes and patterns.<sup>10</sup> Once one has determined by trial and error what frequency and amplitude is associated with a particular shape, it can be reproduced at will by applying the necessary energy at these levels. Similar work to Jenny's is currently being undertaken at the Georgia Institute of Technology, funded by NASA. The project originated as research into the effects of microgravity, but has narrowed down to the effect of subjecting styrofoam pellets to a sound field in a resonant chamber. So far, walls of complex shapes have been produced, by adjusting amplitude, frequency and direction of source, but researchers are confident that "tailoring the sound field to specific shapes and materials appears to be within reach."<sup>11</sup> If this sort of activity is combined with the fact that human consciousness generates electromagnetic waves of particular frequency and amplitude, there is no *a priori* reason to reject the possibility that cosmic creation has followed from consciousness applied in a similar way to a vibratile medium. Whether or not this speculation will lead to scientific discovery, it cannot be ruled out on logical grounds, and thus the onus of its disproof lies on the skeptics.

Such, however, is the unshakeable conviction of most scientists that consciousness has no place in science and, whatever it might be, it is not connected to the real, physical world that there will be an almost reflex tendency to write out of any theoretical script the possibility of a higher consciousness shaping the universe. The cry will certainly be raised that even speculation about it would pollute science with religion, but that is not at all the case, for while the hypothesized higher consciousness may be identified with the traditional God (replacing the "old man in the sky" model), religion proper is based on the quite separate hypothesis that a creating higher power is in communication with the human race. This, the faith of the religionist, is a totally different proposition. In the examples briefly cited above we seem to have a mass of experimental results with no theoretical framework within which to interpret them, and in this situation the proper attitude of the scientist *as scientist* is surely not atheism (which itself is equally a matter of faith) but agnosticism, accepting what can be logically or experimentally demonstrated and standing back from anything else.

Jahn is not alone in conducting experiments to determine whether or how consciousness can influence inanimate processes, but he has

particular authority because he is a Dean Emeritus of the Mechanical and Aerospace Engineering Department at Princeton University. That his work is not well known among mainstream scientists is ultimately a reflection of their need to stay within the Cartesian framework of science, for few individuals are tough-minded enough to cope with anomalies as serious as he is exploring or eminent enough to break ranks without ending their career as scientists. The history of science repeats itself here, in an ironic way, for just as Galileo could not persuade doubters to look through his telescope for proof, the pioneering scientists who work in this disputed territory of mind and matter have difficulty in persuading their fellow scientists to take a critical interest in the available literature.

In this situation, it would make sense to preach to those who have no predefined position to defend, and this might be done most effectively by arranging an *experimentum crucis* as a public demonstration. This would be possible by wiring a large building, already marked for demolition, with explosives which could be detonated by a microswitch capable of being triggered with minimum energy, presumably at the quantum level. The aim of the experiment would be to prove that the power of will was sufficient to trip the switch, and a number of people could be brought together to focus their minds on doing this. Ambient conditions would need to be optimized, and then a signal given for consciousness-focusing to commence. If the building collapsed with a mighty bang from the explosive charges, it would prove dramatically that a certain amount of coherent energy of consciousness had been generated by the participants and had tripped the switch. Of course, it might not work, but if it did, a new scientific theory of creation would become a possibility. One can imagine the impact such an experiment would have if carried out on television as part of the BBC Christmas Lectures. Other less dramatic experiments might be carried out in far from equilibrium conditions, such as creating crystals in a supersaturated solution by directed consciousness. The point is that the energy of consciousness is a very small physical force, and thus experiments must be designed with this in view. It might perhaps be worth drawing attention to the fact that gravity too is an extremely small force on an atomic scale, but capable of driving the planetary bodies on the large scale.

### **The Mechanism of Creation**

Current cosmology postulates that the various structures of matter in the universe, from galaxy clusters to stars, planets and their satellites,

were formed by a simple process of aggregation of cosmic dust under the influence of atomic gravity. This might be explained by a combination of the very short range Van der Waal's force and random movement of atoms in free space. However, it leaves an obvious and fundamental theoretical gap, with no plausible explanation of why the cosmos should have the large and small scale structures revealed by the astonishing advances in telescoping of the past century. There is clearly a hierarchy in cosmic structures and an ongoing creation which cannot be explained by the hypothesis that these structures are essentially magnifications of random irregularities in the primeval fireball. The latter says nothing, in any event, of how and why these notional irregularities were there in the first place. At the Planck scale we simply have no idea of what forces are at work, and to call upon randomness in this way as an all-purpose and arbitrary answer to fill so massive a theoretical gap is hardly more enlightening than invoking the God of the gaps. The question now appearing is, how can the hierarchy of cosmological structures be accounted for and how can it be harmonized with physical theory at quantum level?

The only well recognized theory which does not make randomness a central element is that of Georges Lemaitre, who interpreted Hubble's data to propose that the universe had its origin in a "primeval atom" of immense energy, which had divided, almost by mitosis, as the cosmos had expanded. Lemaitre's speculation had some sympathizers among other great physicists of the period, notably Millikan and Eddington, the latter, in typical bravura style, calculating that 262 divisions would be needed to provide the  $2^{262}$  protons which, he had confidently estimated constituted the sum total of protons in the cosmos. The logical attraction of Lemaitre's solution, in over-simplified form, was that the same rotational forces which were known to operate within the atom should be replicated on different scales, all the way up to the galactic. The theory of the primeval atom, though well known, is largely neglected and discredited today, since there seems to be no way in which it can be taken from the status of conjecture to theory. Yet the basic idea has considerable appeal at an intuitive level, much as Copernicus's original heliocentric theory appealed but was not developable until further data had been provided by Kepler.

Much new astronomical data has been used by Ernest Sternglass<sup>12</sup> to revive and extend Lemaitre's theory, but with the significant difference that he posits the original seed as an "atom" of positronium – i.e., an electron and anti-electron orbiting each other at a distance sufficient to stop mutual annihilation or, strictly speaking, return to

two massively energetic photons. The correction is important, for particle annihilation is yet another example of loose terminology in physics that subtly distorts understanding. In this instance, one must conclude that both matter and antimatter emerged from photonic energy as a consequence of a symmetry-breaking which created two different chiralities (i.e., clockwise and anticlockwise motion) and that so-called annihilation is really a return to the initial symmetry.

To Lemaitre's broad principle Sternglass adds new material and hypotheses, creating a much more coherent theoretical structure. Among these are:

- (1) the evidence of newly forming galaxies containing stars emitting blue light, as reported in the May 30, 1997 issue of *Science*,
- (2) quasars and small galaxies which appear to be ejected from the centres of larger galaxies, and are unexplainable by standard cosmology,
- (3) abnormally high redshifts in some galactic regions,
- (4) a peak in the number of quasars that exist at the same distance from earth as the peaks in newly forming galaxies,
- (5) the apparent evolution of galactic shapes, from round to spiral, as new galaxies evolve,
- (6) recently discovered clustering of galaxies, as reported in the November 1996 *Astrophysical Journal* and January 9, 1997 *Nature*.

This brief list cannot do justice to Sternglass's argument, but suggests at least that the concept of a primeval energy seed now demands reassessment.

The most significant evidence for a Lemaitre type hypothesis is now coming from the WMAP satellite which started in 2003 to send back data suggesting that the cosmos had not come about by homogeneous expansion but by a series of what might be called mini-Bangs, following mini-Crunches. The evidence was indirect and puzzling, for it indicated that the period of ionisation that followed the Big Bang was repeated some 200 million years later. The significance of the data was that the first period of ionisation followed immediately after the Big Bang, when the heat density of a relatively small cosmos was so great as to prevent hydrogen ions and electrons coming together, thus creating a plasma "soup" which blocked the expansionary travel of photons. A second reionisation would therefore seem to demand similar heat levels to those which immediately followed the Big Bang.

Standard cosmology, however, assumes that once the temperature of the cosmos had dropped below a critical level, ordinary matter was able to form, light was able to propagate outward, and cosmic creation continued on its way, with no reason for the plasmoid state to happen again. The WMAP finding thus has “challenged our picture of the universe’s youth and thrown into question what created its architecture.”<sup>13</sup> The central question is, what heat-creating event could have raised an already cooled universe back to the level where ionisation took place again? One tentative suggestion was the anomalous emergence of massive black holes during this period, since only this would account for the huge amount of energy required to effect reionisation. Coupled with Lemaitre’s basic intuition, this makes satisfying sense, for it leads to the conclusion that the early cosmos was essentially a single galaxy with super-energetic stars which went through their normal life cycle to end as multiple black holes, sucking in radiation as they shrank to point size, and then spewing it out again as white holes in multiple Big Bangs, smaller than the primeval event but each one big enough to provide the energy for a galactic cluster.

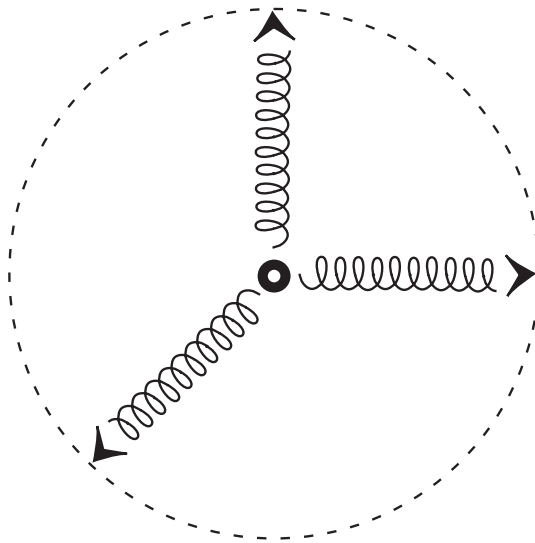
In this scenario the primeval event would therefore act as a seed. The question then arising was, would the smaller Big Bangs that were its progeny each act as seeds in their turn, and was it possible to calculate how many times this process would be repeated until the energy became too diluted? The existence of one unexpected reionisation event has suggested that “there may even have been two separate reionisation peaks, or perhaps even multiple peaks,”<sup>14</sup> which is exactly the scenario that the Lemaitre-Sternglass theory predicts. If this is what actually happened (or is still happening), the process of “cosmitosis”, to coin an appropriate label, would consist essentially of a cluster of smaller Big Bangs following on the collapse to point size of the first generation of super-massive stars and their re-emergence into a 3D domain as white holes. This conjectured process would then be repeated to a limit where there are no stars sufficiently large to generate the gravity required for collapse to point size, and this process may still be under way in some far corner of the universe. The end result would be the kind of cosmic hierarchy which astronomers have observed in the last half century, from galactic clusters through to dwarf galaxies, stellar and planetary systems.

Subsequent data from WMAP has raised this possibility from a speculation to a strong hypothesis, for it has sent back further evidence of reionisation, this time happening a billion years after the Big Bang, which can be explained either by an extremely slow process

of ionisation or by repeated ionisations and coolings. At such great distances in time and space one set of readings is not enough to judge, but as the light from other quasars is examined for similar evidence, the picture should become clearer. The discoverers of the reionisation event favour the latter speculation<sup>15</sup> - i.e., repeated contractions to singularities followed by “mini-Bangs” and ionisations - and this too would be a firm prediction to be drawn from neoscience. The original version of "The Physics of Ultimate Reality" did not take any of this into consideration, since the data was not available at the time, but the most recent data, along with Sternglass's updating of Lemaitre's hypothesis, are perfectly compatible with the ontological principles of neoscience, most notably the real existence of hyperspace.

### From Vibration to Rotation

But why should the primeval electrons spin and orbit in the first place? The answer to this may be found in the field of cymatics by assuming a three-dimensional domain which is brought into existence and kept in existence by what might be called orthogonal pressure axes. The significance of this rather grandiose term may be shown by a simple diagram, thus:



*Fig 2. A representation of dynamic 3-space*

The three “arms” shown as vectors represent three dimensional axes, generated from the same point but separated by solid angles, as one would find at the corner of a cube. As vectors, they represent pressure outward, against the equal and opposite force of resistance to the transformation of 2-space (one may presume) into 3-space. This is merely impressionistic, since there is no reason to think that the cosmos expands like a spherical balloon, but it will serve to make the immediate point, that if the three dimensions are generated asynchronously - that is to say, with one dimensional “thrust” following the other after a very brief interval - a rotational moment is induced in the assumed medium. A “very brief interval” is likely to be in the order of Planck time, and the medium is assumed to be the Casimir plenum which fills space with electromagnetic waves, thus functioning as the controversial aether that was formerly hypothesized to fill empty space. This is a vast area of debate, but the geometrical research of Lissajous, and the vibrational research of Chladni and Jenny noted above indicate that there is strong reason for further study of vibration in more than one dimension. Their findings have been extended by structural engineering theory, and my attention has been drawn to one experiment of extreme simplicity in which ball bearings in a tank of water are set into a mode of planetary rotation by asynchronic vibration of the kind noted here. Unfortunately nothing more can be said here other than this mention, since questions of patent and copyright are still *sub judice*. A further hint that physics may be on the edge of a fundamental new principle which will explain rotational momentum from particle to galaxy comes from advances in computerized design theory and, perhaps surprisingly, from 3D animation, where it seems as though the mathematical function that is basic to computer generation has turned out to be the quaternion. It would be a cause for excitement indeed if this can become central to neoscience, for since Hamilton invented (or discovered) it, the quaternion has been widely considered to be a mathematical answer looking for a physical problem.

### **The Metaparadigm**

The prefix “meta” is frequently used today in both a scientific and popular context to indicate a system which goes so much beyond the norm that it either outdates it or relegates it in importance, in much the same way that a general theory goes beyond and encompasses a special theory. It has been claimed above that neoscience, is a scientific paradigm which is part of a greater metaparadigm in the making. The

metaparadigm will eventually embrace religious and socio-economic paradigms as well as neuroscience in a natural whole, revealing and establishing their interdependency. All three components have been brought together in *Jehovah and Hyperspace* but in undeveloped and impressionistic form. The way in which each of the three paradigms is joined to the others may be briefly summarized as follows. It has already been noted in this introduction that the scientific question of what caused the Big Bang cannot exclude an answer, however tentative, in terms of the energy of a higher consciousness. Thus an overlap between neuroscience and theology, though not with religion proper (as has been emphasized), is potentially there. Neuroscience will, however, have an impact on religion in two obvious respects. Firstly, it is building up a new creation story unlike that in any religion, since it is based on fact and controlled inference. Secondly, the fact that neuroscience is based on the principle of energy transformation and assumes that all the energy in the cosmos was once contained, or located, in the singularity we call the Big Bang, means that everything in existence must eventually be traceable to that singularity. This has potentially revolutionary consequences for traditional religion, since it contradicts the doctrine of creation from nothing, *creatio ex nihilo*, that is at the heart of Judaeo-Christian and Islamic religion. One can foresee this ultimately leading to a redefinition of religion on the basis of a new kind of hypothesized relationship between the human species and the creating power that is its energetic source: to put it rather too simply, religion will enter into a new Axial Age in which its purpose will be understood not as the worship of a higher power – and still less the worship of icons or of human individuals – but as a quest to experience the power itself. What the nature of this experience might be is not within the scope of the present work, or indeed relevant to it: the only point being made is that the logic of neuroscience leads to a different, and higher, definition of the purpose of religion.

As regards the overlap of neuroscience with a new socio-economic paradigm, little more can be said here than what has been said earlier, that to the extent that science provides any society with its most basic world view, the social structures which grow out of it change as the world view changes. Science as normally understood has not only provided a completely different world view from that of the Middle Ages, but a technology which has shaped society in an equally revolutionary way. Neuroscience does not promise any new technological advance, so far as can be seen at this point, but it does offer a new view of what being human means, since it forces recognition that we

are an evolving species. Human-ness is not a static but a developing concept, and just as “being human” today means something vastly different from what it meant a hundred thousand years ago, it means something different from what is to come, however fogged may be our vision of the future. As awareness of humanity evolving grows, so too will grow awareness that if we are to extricate ourselves from the global chaos and violence that intensifies almost daily, we shall have to take an upward step on the evolutionary ladder. Quite simply, we cannot build a different world without a different kind of human being, and as the logic of this comes home, our species will start to form new kinds of community, at every level from the local to the regional and national and ultimately to the global.

Classical and quantum science have given us communications technology which, for the first time in history, makes a global community possible. Indeed, the new technology is slowly forcing a global community upon us, despite the powerful gravity of tribalistic thinking. Neoscience will assist this development not through advancing technology but by taking philosophy forward into new realms, which may at first seem bewildering but as they become more familiar will eventually create a new kind of commonsense, a new world-taken-for-granted. The progression from new philosophy to new commonsense may be slow, but has been exemplified many times in the past. Neoscience is, in fact, the latest step in a continually expanding world view that has always had to contend with the orthodox commonsense of its time. It began with the shift from a flat to a round earth, a speculation which must have seemed pure fantasy to ordinary people when philosophers first proposed it. The process continued with the Copernican revolution, which moved the centre of the universe from the earth to the sun, and this was followed in the last century by what might be called the Hubble revolution, which moved the centre of the universe to the point in space and time that we call the Big Bang, a conclusion which, ironically, Hubble himself was at first reluctant to accept. Though it is now orthodox cosmology, even at a popular level, Big Bang theory was for many years considered notional and speculative at best, and downright wrong at worst, and the name itself was coined by the late Sir Fred Hoyle in derision. The conflict with Steady State theory, which Hoyle and others espoused, was only resolved as the evidence in favour of a one-off starting point tipped the scales. This was scientific theory-building at its best. It is significant that opposition to the Big Bang

came largely from those who could see the theological implications of a postulated creation event.

Neoscience proposes a new vantage point from which to view the universe, and this is above all what makes it a scientific revolution. From the new perspective the cosmos is seen as a domain within some greater hyperspatial reality, and though the way in which the two are related is a question for deeper consideration, it can at least be said that it is not compatible with the so-called “wormholes” currently proposed by speculative cosmology, which supposedly connect the 3D world we inhabit with other imaginary 3D worlds. Once the new perspective on the universe is accepted, it will coexist with the practical daily view, but function as a sort of background to all intellectual activity. The dimensionless and timeless energetic source of the cosmos postulated by neoscience will be seen as the scientific formulation of an intuition which previously has come from poets and seers, and could hardly be better expressed than in the poet T. S. Eliot’s evocative phrase, “the still point of the turning world.”<sup>16</sup>

### **Neoscience and Metascience**

Neoscience begins with physical theorizing, but as its consequences unfold they will be seen to encompass other sciences and questions of what constitutes reality that are normally regarded as the proper subject matter of psychology and philosophy. In this respect, then, it overlaps with metascience, a relatively new intellectual discipline which is not yet represented in all universities, but has departmental status in some.<sup>17</sup> One of its best known proponents, the eminent physicist Mario Bunge, has described the nature and objectives of metascience as follows. It is, he says, “the adequate ground where the integration of science, philosophy and the humanities can be noticed and promoted .... It studies the foundations and procedures of all sectors of verifiable knowledge, from geology to linguistics [and] shows that science is an eminently spiritual activity.”<sup>18</sup> The range of its aspirations, as here expressed, indicates a lack of focus in its definition, and some concluding remarks may help to clarify the scope of both metascience and neoscience and distinguish between them.

Both are disciplines that seek reflex understanding of science: that is to say, they are science thinking about itself, or what J. D. Bernal called “the science of science”. Both seek to identify the principles that merit the term “science” and the reasons why it is considered to have a unique value as a mode of thinking and a truth system. Both are strongly philosophical in orientation. Both examine science not

as a self-contained and self-justifying system but within the context of society, and, in fact, metascience is to be found in some universities in the sociology department. There are, however, significant differences between them, examination of which will throw light on the latent potential of neoscience.

All the differences flow from the fact that metascience has grown out of the study of the history of science, and this principle was, in fact, laid down by William Whewell in his pioneering work of 1837, *Philosophy of the Inductive Sciences*. This historical orientation differentiates metascience from the first rudimentary study of the principles of science that appear in Aristotle's *Posterior Analytics* and also his *Categories* and *Metaphysics*. Neoscience certainly includes many of Aristotle's concerns and, like metascience, takes a historical overview, but its most distinguishing feature is that it is future orientated. In seeking the origin of the physical world, it must propose a kind of science that does not yet exist, and in order to do that, it finds itself having to construct a new system of knowledge rooted in new principles.

The consequences of its futuristic thrust are yet to unfold, but this introduction has shown the general direction of development towards a more humanistic and value-bound science. Building on new epistemological foundations, it will generate deeper self-awareness, and in so doing will eventually be seen as a significant evolutionary step forward for the species. Forced to define its postulates about the nature of reality, it increases self-awareness even more, for it becomes clear that the human being, whether thinking as a scientist or not, can never actually stand outside the world itself as a detached observer except in imagination. We humans are made, like everything else, of the same energetic reality which we set out to study. Thus, in seeking to know more about the energetic origin of our universe, neoscience inevitably moves into what would usually be considered the territory of theology, for we are probing, however speculatively, into the nature of a primal cause, the unmoved mover. In postulating that consciousness is a form of energy that may have triggered the emergence of the cosmos, neoscience goes further still, throwing new light on religious options. In fact, the greatest revolution latent in neoscience may be to bring about a transformation of religious consciousness – redefining fundamental terms, such as *God*, *worship*, *faith*, *church* and *spirituality* - with all the social effects that follow from that. At this point prediction is mostly peering into a misty future, but it can surely be said with certainty that any initiative which promises to

replace historical religious antagonisms with a rational and holistic view of creation is worthy of the most serious consideration.

## References

1. Heinz Pagels, *Perfect Symmetry: The Search for the Beginning of Time*. London: Penguin, 1985. p. 348.
2. John Gribbin, *White Holes: The Beginning and End of Space*. London: Paladin, 1977. p. 188.
3. Quoted in E. Brian Davies, *Science in the Looking Glass: What do Scientists Really Know?*. OUP, 2003. p. 135.
4. C. Reinhard (ed.), *Chemical Sciences in the 20<sup>th</sup> Century*. Weinheim: Wiley-VCH. The quotation (originally in C. A. Coulson's 1952 work, *Valency*) is taken from Ana Simões and Kostas Gavroglu, "Issues in the History of Theoretical and Quantum Chemistry, 1927-1960"). Their introduction deals with "the discourse of quantum chemistry as the confluence of the traditions of physics, chemistry and mathematics ... the ontological status of resonance [and] the impact of large scale computing." The availability of computing power in physics has played an enormous part in shaping the current objectives of science. One recalls the quip that to the man who invented the hammer everything started to look like a nail.
5. Ronald Knox summed up the philosophical problem in a limerick which, though well known, is worth quoting for its wit:

*There once was a man who said, "God  
Must think it decidedly odd  
If he finds that this tree  
Continues to be  
When there's no one around in the Quad."*

To which came an anonymous and equally witty reply stating the theist's argument:

*Dear Sir, Your astonishment's odd.  
I am always about in the Quad.  
And that's why the tree  
Will continue to be,  
Since observed by, Yours faithfully, God*

6. J.Y. Lettvin, H.R. Maturana, W.S. McCulloch and W.H.Pitts, "What the Frog's Eye Tells the Frog's Brain," Proc. IRE 47 (1959), 1940-51. Reprinted in Warren, S.M., *Embodiments of Mind*. Cambridge, Mass: MIT Press, 1965.
7. See, e.g., David Hestenes, "Zitterbewegung in Radiative Processes." In D. Hestenes & A Weingartshofer (eds.) *The Electron*. Dordrecht: Kluwer Academic Publishers. pp. 21-36. Elsewhere Hestenes argues plausibly that "the Dirac theory reveals that  $i\hbar$  has a geometrical meaning relating to electron spin". (From the abstract of "The Kinematic Origin of Complex Wave Functions", in W. T. Grundy & P. W. Milloni, eds. *Physics and Probability: Essays in Honor of Edwin T. Jaynes*. CUP, 1993, pp. 153-160.) I have relegated this quote to an endnote, for the paradoxical reason that it seems to me of such fundamental importance to physical theory, neuroscience and metascience that an attempt to explore its implications in the main text would collapse entirely the thematic structure of this modest book.
8. References are available on Robert Jahn's website. The most relevant to the present argument (co-authored with Brenda Dunne) is probably "On the Quantum Mechanics of Consciousness, with Application to Anomalous Phenomena." *Foundations of Physics*, 16 (8): 721-772 (1986).
9. E.F.P. Chladni, *Die Akustik*, 1802. There does not appear to be an English translation, but his essential ideas can be found in Mary D. Waller, *Chladni Figures*. London: G. Bell, 1961.
10. Hans Jenny, *Cymatics*. Newmarket NH: MACROmedia, 2001. two original vols. in one. Jenny acknowledges Chladni's work, and that of the French mathematician Jules Lissajous (1822-80), whose work on pattern creation through harmonic motion is well known. Lissajous' figures, after being regarded as little more than an interesting oddity, have come into their own with computer graphics. Jenny has produced rotational movement in powders, but drawn no general conclusion from this. (cf. pp. 165-8).
11. Microgravity conditions were created by doing the experiment in a plane when it came out of a steep climb and before it turned downward. For a brief period this created weightless, or near weightless, conditions. A wealth of material, both technical and popular, can be found on the Web under "acoustic shaping".

12. See Ernest Sternglass, *Before the Big Bang: The Origins of the Universe and the Nature of Matter*. NY & London: Four Walls Eight Windows, 2001. 1<sup>st</sup> edn. 1997.
13. Steve Nadus, "Flash and Burn", *New Scientist*, Feb. 21, 2004. p. 32.
14. *loc. cit.*
15. J. Stuart, B. With and A. Loeb, "A large neutral fraction of cosmic hydrogen a billion years after the Big Bang," *Nature* 427, 815-817.
16. T. S. Eliot, "Burnt Norton," Part 2, *Four Quartets*, (1936)
17. In a paper "On the Term Metascience and the Associated Concepts" delivered to the 1986 World Congress of Sociology Alberto Marradi, Professor of Methodology at the Universities of Bologna and Florence, traces the first use of the term "metascience" to 1950. By 1968 its currency was recognized in a book with the title of *Contemporary Schools of Metascience*, and in 1985 a journal entitled *Metascience* was founded by the Australasian Association for the History, Philosophy and Social Studies of Science. The text of the paper is available on the Internet.
18. Mario Bunge, *Metascientific Queries*. Springfield, IL: Charles Thomas, 1959. p. 21.