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Mind over Matter: The Coming Revolution in the Natural Sciences

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What I would like to do despite the strictures of time and the complexity of the subject matter is to describe briefly a revolution in thought that I believe is taking place today in various segments of the scientific community. I also believe that it is a characteristic of such revolutions that they remain virtually unrecognized by the mainstream thinking of the very communities in which they are occurring. This is an illustration of what I call the First Corollary of Environmental Perception, which states that "it is impossible to perceive any environment except from the context of another." It is especially true in many universities, where the habits and traditions of thought, though different perhaps from those of the past, are almost as deeply entrenched today as they were in, say, the universities of medieval Europe. Thus, the First Corollary of Environmental Perception applies not simply to physical environments but to environments of thought as well. It perhaps helps to explain why historians today can speak so easily of a period called the Middle Ages while people living at the time could not.

Because I believe we are in the midst of a revolution in thought, I think it appropriate to begin my comments with two short quotes from Thomas Kuhn, who, as many of you will know, was at the time of his death Laurance S. Rockefeller Professor of Philosophy at MIT.

In 1962 Kuhn wrote what has become a classic on the changes in scientific thought entitled *The Structure of Scientific Revolutions.* I find it remarkable that so many of the people to whom it is addressed are unfamiliar with it. First published in 1962 as part of *The International Encyclopedia of Unified Science,* it was reissued in a separate edition in 1970 and, it is from this latter edition that I quote. Kuhn says:

> Political revolutions are inaugurated by a growing sense, often restricted to a segment of the political community, that existing institutions have ceased adequately to meet the problems posed by an environment that they have in part created. In much the same way, scientific revolutions are inaugurated by a growing sense, again restricted to a narrow subdivision of the scientific community, that an existing paradigm has ceased to function adequately in the exploration of

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> an aspect of nature to which that paradigm itself had previously led the way.[1]

And then again he states:

> Normal science, the activity in which most scientists inevitably spend almost all their time, is predicated on the assumption that the scientific community knows what the world is like. Much of the success of the enterprise derives from the community's willingness to defend that assumption, if necessary at considerable cost. Normal science, for example, often suppresses fundamental novelties because they are necessarily subversive of its basic commitments.[2]

On the sixth of December of 1993, a short essay appeared on the editorial page of the *Wall Street Journal*. It was written by Stephen Meyer, a professor of history and the philosophy of science at Whitworth College in Spokane, Washington. Meyer describes events that took place in the fall of 1992 at San Francisco State University when a professor of biology by the name of Dean Kenyon was prohibited by his department chairman from teaching courses in introductory biology.

Professor Kenyon, who holds a Ph.D. in biophysics from Stanford University, is described by Stephen Meyer as "an authority on chemical evolutionary theory." In a book he co-authored in 1969 entitled *Biochemical Predestination*, Professor Kenyon explained the process by which living cells might have emerged from the chemicals present on the early earth. Since then, Kenyon's research has led him to conclude that no such evolution could have taken place without the "guidance" of some form of "intelligence." In short, he has come to believe that something like "mind" had a role in shaping life. The chairman of the biology department removed Kenyon from any further involvement in the classroom because he said that Kenyon was teaching "religion."

Stephen Meyer in his essay comments, "The simplistic labeling of Mr. Kenyon's statements as 'religion' and the strictly materialistic view as 'scientific,' seems entirely unwarranted. Biology texts," he continues, "routinely recapitulate Darwinian arguments against intelligent design. Yet if arguments *against* intelligent design are philosophically neutral and strictly scientific, why are Mr. Kenyon's arguments *for* intelligent design inherently unscientific and religiously charged?"

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1. THOMAS S. KUHN, THE STRUCTURE OF SCIENTIFIC REVOLUTIONS 92 (2nd ed. 1970).
2. *Id.* at 5.

In the December 15, 1993, edition of the *Wall Street Journal,* all the letters to the editor took part in the debate. Letters appeared again in the editions for January and February. There were probably other letters I did not see. The debate was waged with an intensity that reminded me of that time early in the history of medieval universities when professors were required to sign an oath that they would teach nothing that was contrary to the writings of that greatest of dead authorities, Aristotle, who, as you will remember, had lived 1700 years earlier.

To more fully understand something of the origins of the debate created by Meyer's essay, I would like to take a circuitous but, I believe, necessary journey back to the time of another revolution in thought and to the debates by which that revolution was defined. I am speaking of what has been called the Copernican Revolution and the subsequent trial of Galileo in 1633.

Nicholas Copernicus died in 1543. Historians tell us that friends placed into his hands before his death a copy of his newly printed book on the universe—*De Revolutionibus Orbium Coelestium* [*On the Revolution of Heavenly Bodies 1*]. In it he described his hypothesis that the earth along with the other planets revolved around the sun. He had waited 30 years to publish his ideas and only did so toward the very end at the urging of two powerful members of the Catholic Church, his old friend Canon Tiedemann Giese of Frauenburg in East Prussia and Nicholas Schoenberg, Cardinal of Capua and the confidante of Pope Paul III, to whom Copernicus had dedicated his book.

So here was the Catholic Church urging Copernicus to publish his hypothesis, and yet 90 years later the Church would force the nearly 70-year-old Galileo, under threat of torture, to abjure his support of the Copernican hypothesis, and they would then place him under house arrest for the remaining nine years of his life. How could such an apparent reversal in the Church's position have taken place? I would suggest that in the answer to that question lies the real meaning behind what we call the Scientific Revolution.

Prior to Copernicus, the model of the universe that had dominated European thought for more than 1400 years was the one described by the Greco-Egyptian astronomer and geographer Ptolemy, who lived and wrote in Alexandria, Egypt, in the second century A.D. In his 13-volume work known as the *Almagest,* he described a universe at the center of which the round Earth stood motionless, while orbiting it in concentric crystalline spheres were the seven known planets, including the sun and the moon. Surrounding them was an eighth sphere containing all the fixed stars, and surrounding that an invisible sphere called the Primum Mobile, or First Mover. It was a remarkably ordered and harmonious universe consisting of a satisfying compendium of

Pythagorean, Aristotelian, and Christian thinking. I am assuming that its structure is familiar enough not to need further detail, as the issue that is most important to us here is whether people living in the Middle Ages believed that this was actually the way the universe was.

Undoubtedly for many people, if they thought about it at all, some basic elements of the Ptolemaic universe formed a real but hazy and ill-defined part of the fabric of their mental environment—almost like the wallpaper in the room of a house in which we once lived as children. Just as then, there are people today who, if asked, might say they visualize the atom as a miniature solar system with a sun-like atomic nucleus orbited by planet-like electrons. This metaphor for describing what cannot be seen was first suggested by quantum physicist Neils Bohr in 1913. While taken literally by some, perhaps, it is clearly understood by the established scientific community as a convenient fiction for what is impossible to visualize.

In the same way, the medieval establishment, made up of Church and university, would have treated Ptolemy's thinking as hypothesis only—as a convenient model for "saving the appearances of the celestial phenomena," as they would have expressed it then. We find this a difficult idea to understand today because for us to see the universe through medieval eyes requires us to interpret the data very differently than we are used to doing. The Church's premise would have been that God could cause things to happen in the universe in any way He chose, and this would include ways beyond human comprehension. Humans might see the effects of those causes but they could never know for certain what brought them about. Thus, early cosmographers were limited to speculations called hypotheses. They were tools that explained how nature appeared to work, but no thoughtful person confused them with the truth. And the Church made certain that was very clear.

And so it was in precisely this same light that the Church urged Copernicus to make public his hypothesis. From what the Church knew of the Copernican model before it appeared in print, it was simpler than Ptolemy's model in the number of variables needed to explain planetary motion, and it was also understood to be more accurate in predicting those motions. This latter capability, as applied to the motions of the sun and moon, was, of course, crucial to the Church for fixing the date of Easter on which so many other dates in the Christian calendar depended.

Galileo turned all of this inside out, but not because, as most of us learned in school, he introduced a revolutionary view of the universe that contradicted the Church's rigid commitment to the Ptolemaic view. His threat was of an entirely different order. What Galileo was saying by implication about Copernicus was that if an hypothesis "saves all the appearances," then it is the same as the truth. It is no longer just a model. It is a description of the way things really are.

The English literary scholar C.S. Lewis describes the significance of this idea in his book *The Discarded Image.* He speaks of Galileo's impact this way:

> The real reason why Copernicus raised no ripple and Galileo raised a storm may well be that whereas the one offered a new supposal about celestial motions, the other insisted on treating this supposal as fact. If so the real revolution consisted not in a new theory of the heavens but in a "new theory of the nature of theory."[3]

It seems to me that Galileo's idea was strikingly similar to one expressed by Martin Luther a hundred years earlier when Luther argued that the individual human being could seek salvation directly through his own experience of God without the intermediary of the Church or its representatives. Galileo was saying that, if an individual through his own sense experience could develop a hypothesis that explained how everything appeared to the senses, then that would be the same as the truth. And there would be no need for the Church to explain the phenomena in its own terms. In both instances, the Church perceived its authority to be at bay and fought back with all the considerable power it possessed.

But Galileo did much more than validate our reasoned sense experience as a map of reality. He changed the very way that people from that time onward would think about the physical world.

In 1623, Galileo published a book called *The Assayer* or, in Italian, *II Saggiatore.* It was a scathing and completely unfair attack on a work about comets by a prominent Jesuit astronomer named Horatio Grassi. It represented the beginning of Galileo's downfall, a downfall brought about to large degree by his own intractable arrogance. It is in *The Assayer,* however, that Galileo makes two statements that were to form the foundation for all future scientific thought. This is the first one:

> "Philosophy [natural science]," he wrote, "is written in that vast book that stands forever open before our eyes, I mean the universe; but it cannot be read until we have learnt the language and become familiar with the characters within which it is written. It is written in mathematical language, and the letters are triangles, circles, and other geometrical

3. C.S. LEWIS, THE DISCARDED IMAGE 16 (1964).

figures, without such means it is humanly impossible to comprehend a single word."[4]

R.G. Collingwood, the brilliant English polymath who was Wayneflete professor of philosophy at Oxford University and who died in 1943, commented on this statement by Galileo in his marvelous little book entitled *The Idea of Nature*. Collingwood says,

> With Galileo the modern science of nature reaches maturity. It was he who first laid down clearly and finally the terms on which nature could be an object of adequate and certain scientific knowledge. In a word, these terms were the exclusion of everything qualitative and the restriction of natural reality to a complex of quantities....The principle of science as understood by Galileo is that nothing is scientifically knowable except what is measurable.[5]

The second foundation stone in the edifice of modern science that was laid by Galileo was the distinction he drew between the observer and the object of observation. As far as I know, he was the first person in Western science to have made such a distinction. He wrote that all objects have two sets of qualities, which he labeled primary and secondary. Primary qualities are those that are inherent in the object itself and, thus, exist independently of any observer. They include such qualities as motion, figure (or shape), extension in space (length, breadth, and width), solidity, and number. The secondary qualities are such things as color, sound, taste, and smell, as well beauty and ugliness. These are qualities that exist only in the senses and mind of the observer. In *The Assayer* he states,

> I think that if ears, tongues, and noses were removed, shapes and numbers and motions would remain, but not odor or tastes or sounds. The latter, I believe, are nothing more than names when separated from living things.[6]

In these words we can see the beginning of that objectification of nature that came to characterize scientific thought between the seventeenth and nineteenth centuries. This polarization of nature into the observer and the observed led to a world that now had both an

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4. GALILEO GALILEI, II SAGGIATORE; *as quoted in* R.G. COLLINGWOOD, THE IDEA OF NATURE 102 (1960).
5. R.G. COLLINGWOOD, THE IDEA OF NATURE 103 (1960).
6. GALILEO GALILEI, II SAGGIATORE, *as quoted in* ARTHUR KOESTLER, THE SLEEPWALKERS 469 (1959).

"inside" and an "outside." It was this growing awareness of the apparent separation between the "me" and the "it" that, I believe, gave rise to modern human self-consciousness. But it also gave rise to a world of objects and events whose existence was independent of any observer and whose behavior was governed by universal laws.

That view is so familiar to us today that we cannot see it as a way of looking. We see it simply as the way things are. This illustrates what I call the Second Corollary of Environmental Perception, which states, "We tend to remain unconscious of those elements in our environment for which there are no exceptions."

Perhaps it might be appropriate here for me to apologize for spending so much time with Galileo. He is referred to so frequently, however, as representing the beginning of the Scientific Revolution that I thought it might be valuable to provide a slightly different context for that statement than is usually done. In the end I trust it won't seem time poorly spent.

The French philosopher and mathematician Rene Descartes was 46 years old when Galileo died. He had been much influenced by Galileo's thinking and equally so by that of the English philosopher-statesman Francis Bacon. Bacon's ideas about a nature that was governed by discoverable laws, coupled with Galieo's conviction that the language of those laws was mathematical, led Descartes to imagine a utopian world in which a universal science based on mathematics would lead to human happiness through the control of nature. But it was not until the end of the seventeenth century that the giant mind of Sir Isaac Newton brought all these ideas together. In 1687 he published his great work the "Principia."[7]

Building on Galileo's work on the trajectory of cannon balls and the acceleration of falling objects, and building, too, on the work of Johannes Kepler, who believed that magnetism might explain how planets moved in orbit around the sun, Newton created a new synthesis with his idea of a law of universal gravity. His was uniquely a mathematical description—one that could predict the flight of cannon balls, the behavior of falling stones, or the orbit of the moon around the earth.

We have forgotten how difficult it was for Newton to accept the idea of gravity—to accept the existence of an invisible but measurable force that acted everywhere across empty space. Writing to his English friend Bentley after the "Principia" was published, he said,

7. *Principia Mathematica Philosophiae Naturalis* [*The Mathematical Principles of Natural Philosophy 1*] [hereinafter *Principia*].

> That gravity should be innate, inherent and essential to matter, so that one body may act upon another at a distance through a vacuum, without the mediation of anything else...is to me so great an absurdity, that I believe no man who has in philosophical matters a competent faculty of thinking can ever fall into it.[8]

So Newton was never certain about the nature of gravity. On the one hand in describing it as a purely physical force he explained that it traveled through space by means of an invisible substance called the ether that propagated gravity much as air propagates sound. On the other hand, he believed that gravity might be a measurable yet unexplainable expression of God's power. In the notes at the very end of the "Principia," in acknowledging that his work left many things unanswered, he concludes, "the supremely elegant structure of the solar system cannot have arisen except through the device and power of an intelligent being."[9] This sounds remarkably like an echo of something said more recently by Professor Kenyon of San Francisco State University.

That change in the perception of nature that we call the Scientific Revolution was characterized by the slow but inexorable disappearance from the universe of both "being" and "purpose." In Galileo, Descartes, and especially in Newton, there can still be found on examination what I would describe as a "residual of divinity." But what was remembered by later scientists about Newton, for example, was not his belief that gravity was a manifestation of God's mind. What was remembered was Newton's mathematics and the predictability they offered when applied to the motions of bodies in space. The idea of a divine mind, if there was any longer a need for one, was relegated to the original act of creation. By the end of the eighteenth century, the universe itself had become a great machine governed by knowable laws.

So far in this discussion we have focused on some of the people and events that led gradually to what might be called the "objectification" of nature and to a view of the universe as a machine governed by physical laws. What we have not traced over time is the evolution of this same kind of thinking as applied to the world of living organisms. If there were time for a discussion of this process, we certainly would have to include the work of the early English naturalist John Ray, a contemporary of Galileo, Kepler, Descartes, and Newton, whose interest in classifying living plants and animals gave modern

8. *Principia, quoted in* ARTHUR KOESTLER, THE SLEEPWALKERS 503 (1959).
9. *Principia, quoted in* R.G. COLLINGWOOD, THE IDEA OF NATURE 108-09 (1960).

meaning to the word "species." We would have to include, as well, that most prominent of classifiers, Linnaeus, and the early French evolutionists Charles Bonnet and a bit later John Baptiste Robinet. Also from France would come the remarkable work of the Comte de Buffon, whose 44 volume *Histoire Naturelle* stands as a synthesis of living nature that is to the eighteenth century what Newton's "Principia" was to the seventeenth.

In the early eighteen hundreds there would be Georges Cuvier and Lamarck. The former, whose theory of life-shaping catastrophes, and the latter, whose theory of the inheritance of acquired characteristics, would each represent, as did all those who went before them, but one more form in the evolution of the idea of evolution. The word "evolution" is, for most of us, synonymous with the name of Charles Darwin—so much so that some people believe that evolution is something that Darwin himself "discovered." But Darwin's great contribution was to define the process through which evolution expressed itself in nature. He called it natural selection.

Today we encounter the idea of evolution almost everywhere—in a book title on the "evolution" of economic theory, on a radio program on the "evolution" of rock music, or in a lecture about the "evolution" of jet aircraft. "Evolution" has thus become a metaphor for changes of all kinds, most of which have no relation to biological evolution whatsoever. In fact, the metaphor of evolution so permeates the fabric of our thinking that it is hard for us to imagine that for centuries no such concept existed. Another way of expressing this would be to say that until humans could conceive of the idea of evolution there could be no "discovery" of the process of evolution in nature. The idea had to be present in the human mind before the world could be seen in that way. Quite clearly, I think this suggests that as the mind itself evolves so nature, too, is changed. The difficulty we have in being aware of this process is revealed by what I call the Third Corollary of Environmental Perception. It states that "we must first know *that* something is before we can discover *what* something is."

The Origin of Species was first published in November of 1859. In his book Darwin described a random and mindless process of natural selection that over hundreds of millions of years had given rise to the multiplicity of forms of life both past and present. It was a perception that saw nature as a collection of discrete objects whose form and function were governed by predictable laws that could be discovered by the human mind. It was a perception that intensified the polarization of the world into the observer and the observed.

It is important to note in this context that, while the nineteenth century represented the culmination of this perception of nature as object, it was also the time of that pioneering work by Wilhelm Wundt in Germany, and later by Sigmund Freud and Carl Jung in the exploration of that vast interior universe we call the mind. Thus, Darwin and Freud might be said to represent the polarities of the objective and subjective view of the world. With them the separation between the "outside" of nature and the "inside" of nature was complete.

Then Darwin's contemporary, Alfred Russel Wallace, whose work in Brazil and the East Indies led him to conclusions about evolution that were similar to those published by Darwin, made a comment that throws an entirely different light on these matters. In his book *Man's Place in the Universe*, published in 1903, Wallace stated, "The marvelous collection of forces which appear to control matter, if not actually to constitute it, are and must be mind products."[10]

Now we are venturing here on to very thin ice. It is difficult to determine what Wallace meant by the word "mind." There is no evidence, however, that we must assume he was speaking of that "residual divinity" to which I referred in relation to the thinking of the seventeenth and eighteenth centuries. What Wallace's statement does offer to us is the opportunity to reexamine what *we* mean by the word "mind."

So let me very briefly pose a kind of thought experiment.

If we were to take a walk in the woods, we might find ourselves crossing a narrow stream, and there we notice that some ten or twelve small stones have been removed from the stream and laid by the side of the path in the shape of an arrow. Clearly someone has done this, and so we feel no hesitation in arguing that the arrow is a manifestation of mind. It would never occur to us to take a geologist's hammer and begin breaking open the stones in search of the mind inside. It is not the individual stones or something in them that reveals the presence of mind. We would say it was their pattern. But then if we looked to either side of the stone arrow we might see a tree. We would be able to identify it, too, by its pattern of bark, its leaf shape, and even its overall outline as a maple tree. But it would never occur to us to suggest that its pattern was a manifestation of mind. We would say it was an object.

For us mind is assumed to be something contained in our heads. And while we would perhaps agree that our heads and our bodies are objects like the tree, we would insist there is something more inside us that is not just object. So strong is this conviction that we resent it when hospitals, corporations, or governments treat us as if we were only

10. ALFRED RUSSEL WALLACE, MAN'S PLACE IN THE UNIVERSE (1903), *quoted in* STEPHEN J. GOULD, THE FLAMINGO'S SMILE 397 (1985).

objects. We insist that we be treated as people—that unique combination of object and mind. But it never occurs to us to attribute this same dual nature to nature herself. For us nature is only object, whether the nature to which we refer is maple tree, atom, or galaxy.

There are two unquestioned assumptions on which we base this belief. The first is that mind, our mind, evolved over millions of years out of mindless matter. And the second assumption is that mind is limited to humans and a few of the higher animals. All around us we see countless physical objects that are manifestations of mind—computers, screwdrivers, books, houses, cars, television sets, and scud missiles. And while our senses perceive them as objects separate and distinct from us, we can perhaps understand, when we stop to think about it, that they came into existence only through mind—our mind. But we find it almost impossible to entertain the idea that the maple tree by the path, or the frog in the stream, or even we ourselves are products of mind. These, we say, are the result of mindless evolution, shaped by a randomly operating process we call natural selection. And when we say this we forget that the concept of evolution itself is a product of mind—a way of thinking that must precede our capacity to see nature in that particular way. And to further confound our certainty about what is object and what is mind, of what is outside us and what is inside, today we are told by the particle physicists that the ultimate constituents of all matter appear not as objects but as energy fields—states of being that under some conditions have no mass and cannot be said even to occupy particular space.

I am reminded of a comment made earlier this century by Sir James Jeans, the respected physicist, astronomer, and mathematician. "Today," he said, "there is wide agreement...that the stream of knowledge is heading toward a non-mechanical reality; the universe," he concluded, "begins to look more like a great thought than like a great machine."[11] Here Jeans, like Alfred Russel Wallace, is once again introducing the idea of mind—not necessarily in the form of a "residual divinity," but certainly as some kind of force within nature and perhaps not limited just to the human mind alone. In recognizing the importance of the human mind in interpreting nature he had once said, "The concepts which now prove to be fundamental to our understanding of nature...seem to my mind to be structures of pure thought."[12] Jeans died in 1946 and he was only one amongst many twentieth century scientists

11. JAMES JEANS, THE MYSTERIOUS UNIVERSE 137 (1937), *quoted in* ARTHUR KOESTLER, THE SLEEPWALKERS 531 (1959).

12. JAMES JEANS, THE MYSTERIOUS UNIVERSE 166 (1948), *quoted in* ROBERT G. JAHN & BRENDA J. DUNNE, MARGINS OF REALITY 206 (1987).

who began to raise questions about the role of the observer's mind in determining the outcome of observations.

Werner Heisenberg, a contemporary of Jeans, and one of the founding fathers of wave mechanics and quantum theory, once commented, "What we observe is not nature itself but nature exposed to our particular form of questioning."[13] And Albert Einstein himself spoke of the influence that theory had on observations. He said, "The sense experiences are the given subject matter, but the theory that shall interpret them is man made...it is the theory that decides what we can observe."[14] Einstein went on to offer a caution: "Concepts that have proved to be useful in ordering things easily acquire such authority over us that we forget their human origin and accept them as invariable."[15] I would add here that it is precisely such authority that has been assumed by a mechanistic theory of evolution.

Now let me take the final step that will set us on the journey back to where we started. In 1987, a remarkable but virtually unknown book was published by Harcourt, Brace, and Jovanovitch entitled *The Margins of Reality*. It was subtitled "The Role of Consciousness in the Physical World." Its authors were Drs. Robert Jahn and Brenda Dunne. Jahn is a professor of Aerospace Sciences and Dean Emeritus of the School of Engineering and Applied Sciences at Princeton University. Brenda Dunne is the manager of the Princeton Engineering Anomalies Research Laboratory. Their academic credentials are impeccable.

For nearly two decades Jahn and Dunne have been studying the impact of the human mind on mechanical and electrical systems. Their work grew out of a concern of one of Jahn's graduate students that, as micro-electronic circuits become increasingly smaller and more delicate, humans working with instruments in which such circuits are a component might possibly influence the functioning of those circuits by their own thought processes. Obviously such influence could have important implications in the use of computers, air traffic control systems, and missile guidance devices.

Part of their carefully controlled and thoroughly documented work involved the construction of a testing device called a Random Event Generator. The following description of such a device is taken

13. WERNER HEISENBERG, PHYSICS AND PHILOSOPHY 42 (1958), *quoted in* GARY ZUKAV, THE DANCING WU LI MASTERS 114 (1979).

14. Jonathan F. Lewis, *Theory Building in Sociology: Queen Anne and the Dinosaurs* (quoting Albert Einstein), *in* TEACHING CRITICAL THINKING 89 (John H. Clarke & Arthur W. Biddle eds., 1993).

15. ALBERT EINSTEIN: PHILOSOPHER SCIENTIST (P.A. Schlipp ed., 1970), *quoted in* R.G. JAHN & BRENDA J. DUNNE, THE MARGINS OF REALITY 207 (1987).

from a paper by Jahn and Dunne entitled "Consciousness and Anomalous Physical Phenomena":

> This REG [Random Event Generator] utilizes as its source a commercial electronic noise diode whose output is rendered by appropriate circuitry into a string of randomly alternating binary pulses. A typical experimental *trial* consists of 200 of these pulses, produced at the rate of 1000 per second and displayed to the operator as the number conforming to a regularly alternating +, -, +, -,...sequence, where the theoretical expectation for the mean of any given trial is 100 with a standard deviation of 7.07. (In essence, the process is akin to flipping 200 coins very rapidly and counting the number that conform to an alternating sequence of heads and tails.)[16]

To describe the process in simplified form, an operator attempts by his or her thought to bias the output of the generator by increasing the number of pluses or minuses beyond statistical expectation.

The results of literally millions of tests involving many different participants over some seventeen years reveal that the mind can, indeed, measurably influence the generator's output. And whether that mind is in the same room as the Random Event Generator or whether it is thousands of miles away seems to make no difference to the effect. Now there is neither time nor is it appropriate here to detail the rigorous protocols and the diversity of phenomena tested at Princeton involving literally millions of test results all of which have been logged onto computer. But the implications of this fascinating work ramify into every area of scientific research. Toward the end of their book, Jahn and Dunne consider some of the potential areas for exploration. They write,

> The possibility that consciousness, through intention, can marginally influence its physical reality to a degree dependent on its subjective resonance with the system or process in question has implications that could extend well beyond those portions of engineering science, para-psychology, statistics, and quantum mechanics directly involved in this research, into the life sciences, the social sciences, and the humanities as well. For example, if we look past the technological provinces of microelectronics, artificial intelligence, and information processing, the next

16. Robert Jahn & Brenda Dunne, *Consciousness and Anomalous Physical Phenomena* 5 (Princeton University, PEAR Note 95004) (May 1995).

> evident domain for further assessment of this influence would be that of the living organism. In principle, much of the experimental and theoretical methodology described in [this book] could be directly applied to simple biological systems and processes, particularly those appearing to rely on some form of probabilistic behavior, such as bacteria, algae, or sperm. While only a few basic experiments of this class have been performed and the data are yet too sparse to justify generic claims, evidence has indeed been accumulating to indicate that quite similar marginal biases of behavior can be effected in living systems as well.
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> If consciousness effects in this domain can be more fully established, the implications and applications could range from molecular biology and genetic chemistry on one extreme, to general evolutionary theory on the other. The possibility that cell biology might entail a volitional or teleological component beyond random adaptation would constitute a major branch point in the comprehension and representation of the organizational capability of motivational factors in their assessment.[17]

Now the possibility that the human mind could affect the behavior of living organisms even at the smallest scale would require a rethinking not only of the meaning of mind but of the processes of evolution itself. It would introduce once again the whole difficult question of meaning and purpose in nature.

In numerous conversations with Brenda Dunne about ongoing research in the lab at Princeton, I have also enquired about whether she knew of particular experiments dealing with the influence of mind on living organisms. One paper she sent that I found of particular interest was not produced at Princeton. Written in 1991 and sent to Dr. Dunne, it was entitled "Consciousness Interactions with Remote Biological Systems," co-authored by William G. Braud of the Psychology Laboratory at the Mind Science Foundation in San Antonio, Texas, and by his assistant Marilyn J. Schlitz. The paper details the experimental protocols and the results of their work in measuring remote mental influence on the blood pressure of other individuals, on the spatial orientation of schools of fish in distant aquaria, on locomotor activities of small mammals, and on the breakdown rate of human red blood cells in

17. ROBERT G. JAHN & BRENDA J. DUNNE, MARGINS OF REALITY 324–25 (1987).

solutions of varying salinity. Toward the conclusion of their paper Braud and Schlitz comment,

> In the English language literature alone there are approximately 100 published reports of experiments in which persons have been able to influence mentally, and at a distance, a variety of biological target systems including bacteria, yeast colonies, motile algae, plants, protozoa, larvae, woodlice, ants, chicks, mice, rats, gerbils, cats, and dogs, as well as cellular preparations [blood cells, neurons, cancer cells] and enzyme activity.[18]

Brenda Dunne did not comment on Braud's paper when she sent it to me, and, although I do not feel qualified to evaluate the work scientifically, I can say from reading it that the results produced indicate a measurable function of mind that lies outside our customary understanding of both mind and matter. Among the many interesting issues raised in this paper, one of the most remarkable is that Braud believes that he and other investigators have found a direct correlation between measured fluctuations in the susceptibility of living organisms to mental influence and variations in the activity of the earth's magnetic field.

Certainly there are questions in all of this that are worthy of serious consideration by mainstream Western science. The central unanswered issues, of course, involve an explanation of the relation between mind and matter and of the nature of mind itself.

Sir James Jeans, who was quoted earlier, spoke of the effort to discover the ultimate microphysical constituents of matter and said that, as we do this, "the universe itself looks more like a great thought than like a great machine." He recognized on this scale of investigation the similarity between mind and matter. In continuing that same quote, he said, "Mind no longer appears to be an accidental intruder into the realms of matter; we are beginning to suspect that we ought rather to hail it as the creator and governor of the realm of matter."[19]

Perhaps it was "mind" in this sense to which Alfred Russel Wallace referred when, as I quoted him earlier, he said, "The marvelous collection of forces which appear to control matter, if not actually to constitute it, are and must be products of mind."[20] I think it may be

18. William G. Braud & Marilyn J. Schlitz, *Consciousness Interactions with Remote Biological Systems: Anomalous Intentionality Effects*, 2 SUBTLE ENERGIES J. 35 (1991).

19. JAMES JEANS, THE MYSTERIOUS UNIVERSE 137 (1937), *quoted in* ARTHUR KOESTLER THE SLEEPWALKERS 531 (1959).

20. ALFRED RUSSEL WALLACE, MAN'S PLACE IN THE UNIVERSE (1903), *quoted in* STEPEN J. GOULD, THE FLAMINGO'S SMILE 397 (1985).

possible to imagine that in time we might come to accept that the human mind can have some kind of influence on matter. But a much harder leap for us would be to conceive of mind as existing anywhere but in human heads. I would suggest, however, that this difficulty is a relatively recent habit of our own thinking. Let me explain what I mean.

Some 400 hundred years ago, when Ptolemy's earth-centered universe still formed part of what Western people took for granted about their world, the idea of gravity was limited to the earth. When a stone was thrown into the air and returned to earth, it did so because earth was where stones "belonged." The earth occupied the center of the cosmos and, at the same time, was also the lowest point in the cosmos, and this created for people on earth what one writer has described as a "vertiginous" universe. Everything else was "up" from earth, and earth itself was "down" from everywhere. We can recreate a bit of that feeling today by standing on a hillside on a starry night and looking up at the sky. But back then, everything from flying cannon balls, to falling rain proceeded like homing pigeons to where they naturally belonged. That is what the word gravity meant, and it was easier to *feel* its meaning than to think it. But in the late seventeenth and early eighteenth centuries, as Newton's idea of universal gravity began to spread, people's entire feeling for the cosmos was forced to change. Gravity no longer had any locus; it was everywhere.

Over time people became accustomed to thinking of the universe in the new way. We no longer even question it today, because such thinking is now habitual. Universal gravity is part of the "wallpaper" in the house of our mind. In writing of this interesting transition of perspective from earth-centered gravity to universal gravity, the English philosopher Owen Barfield describes how, just as people in the seventeenth and eighteenth centuries found it initially difficult to adjust to the idea of universal gravity, they, in turn, took for granted something that we find it almost impossible to comprehend. Barfield explains:

> if we really want to put ourselves in their shoes, back at that stage in the history of thought, we must practice thinking, not only about such a thing as gravitation, which is easy for us, but rather about something which is correspondingly difficult. Only in that way can we hope to understand their difficulty in thinking about gravitation at all. To think of gravity, or terrestrial physics of any sort, as extending beyond the orbit of the moon was difficult for them in the same way that it is difficult for us to think of mind, or mental activity, or intelligence of any sort outside of some particular physical brain. Contrariwise, this [which is so difficult for us] was something that caused them no

> difficulty at all...whereas for us the very same words mean the opposite thing—the word "thought", for instance, means, for most people, something rather like cigarettes inside a cigarette box called the brain. One good reason for troubling to concentrate on the moment of change of meaning is that it directs our attention...to fundamental assumptions so deeply held that no one even thinks of making them explicit. Try thinking and speaking about "thought" or "thoughts" in the old way, if you want to experience how difficult it must have been, before the scientific revolution, to think about physics in the new way.[21]

I said at the beginning that I believe we are at the threshold of a revolution in thought. It is already being reflected in the limited but serious research efforts by a small segment of the scientific community to assess the role of mind in influencing matter. I believe the results of that investigation might well lead to the establishment of "mind" as a universal and invisible force as significant to our understanding of the structure of the universe as was the concept of a universal and invisible force called gravity. I also believe that, in the context of this investigation, universal mind, of which our own minds may well turn out to be part, will be seen to be completely within the realm of what we call nature, and that there will be nothing about it that is mystical, religious, or supernatural.

And who knows? Some day, Professor Kenyon of San Francisco State University, whose story began this journey over a decade ago, may be back in the classroom teaching his students a very different way of looking at evolution.

21. OWEN BARFIELD, SPEAKER'S MEANING 45, 46 (1967).