Chapter 2
Space/Time in Post-Einsteinian Physics

Most of us are aware that something happened to our concepts of space and time in 20th century physics, but few of us fully understand what that was. And still fewer of us believe that whatever is going on in the esoteric discipline of physics has anything to do with our daily lives. While we are indeed immersed in the technological wonders of science including space ships, satellites, computers, and the prospects of a nuclear war, few of us are as curious as we might be about understanding the natural cosmos or about understanding the essence of the scientific method of truth. So the 20th century revolution in physics can seem quite distant from the vital concerns of most people.

I want to tell about this revolution in physics in fairly simple terms in order to enlist more of us into the task of doing responsible "metaphysics" about this strange physics that is actually taking place in our culture today. I will focus mostly on our images of space and time.

Geometry and the Physical World

Whether we loved or hated high-school geometry, our minds have been shaped by Euclid's geometry. Perhaps Euclid, 2300 years ago, simply noticed how our minds were shaped and put that down in a systematic fashion. And since that time, all thinkers and non-thinkers in all Western cultures have simply assumed that the physical world was shaped according to the mathematical abstractions of Euclid's geometry. We may have heard that according to Einstein and his successors the physical world does not correspond to Euclidian geometry, but such thinking seems to apply only to people who want to think about such things. Fortunately, for most nearby practical processes Euclid's axioms work pretty well.

Anyhow, most of us continue to assume that our surroundings are part of a vast physical space that can be extended endlessly up and down, back and forth, and out and back. So the idea of living on the "surface" of some kind of fourth-dimensional sphere of ever-changing shape is, well, hardly worth thinking about.

We also assume that time can be pictured as another infinite line (or at least a very long line) moving from a very distant past to a very distant future and that this line of time has no influence on the three dimensions of space. We might say that time moves through space or that space moves through time without bothering to notice one another. Euclidian minds realize that they live in both space and time and that space and time are both elements of our single cosmos; however, until Einstein's revisioning, we humans did not dream that the actual physical world is a fabric in which the shape of time is influenced by space and the shape of space is influenced by time. We had assumed that space just had one shape--straight line infinite extension in six directions. We assumed that the distance between two point in space has one length, and that this length remains the same no matter who measures it from whatever position in the universe. We have also assumed that if two events are simultaneous to one observer, they are simultaneous to observers everywhere. All these assumptions are just "common sense" to a Euclidian-trained mind. The notion that the physical world might actually operate differently from these assumptions was, until Einstein's revisioning, "unthinkable," as we say.

Indeed for a majority of people, the Einsteinian cosmos is still unthinkable because they have not gone to the trouble to think about it. Perhaps most of us are reluctant to think that our

human thinking can undergo changes that are this far-reaching. And if it can, we hope it will change back to something with which we are more familiar. In other words, most of us would like to think that the truth of the physical world is basically what we already think it is. Furthermore, we don't want to have to think about thinking or about how or whether thinking is true or false. And most of all we are especially reluctant to embrace the notion that all thinking is vulnerable to being rethought in a more realistic manner.

So what is the nature of the Einsteinian rethinking about space and time and why do we need to prefer it over the thinking that seemed good enough for more than twenty-three centuries? First of all, Einstein realized that measuring time and space had to be done in relation to a measurer, an observer of that space and time. And this measurer was in time and in space, not off somewhere looking at time and space as if time and space were a poster on the wall. Physical reality is not something we observe "over there" while we somehow stand out of it and look at it. We do our looking from some particular location in space and time. We are positioned at some space/time coordinate observing the expanse of space and the passage of time.

Looking with Light

In vast cosmological matters, we do our observing with the eyes, with the incoming of light (or with instruments that respond to other electromagnetic radiations). Our access to the stars is only through the spreading through space of electromagnetic radiations: radio waves, infrared radiation, light, ultraviolet rays, X-rays, gamma rays, etc. Contemporary physicists also know that light does not travel from point to point instantaneously, but takes a period of time to travel from point to point. This has been carefully documented by all sorts of experiments. Physicists have even measured quite accurately the speed at which light moves.

So we are always seeing things in the past. If we are looking across the room at something, we are seeing that object as it was in the extremely recent past, for light travels exceedingly fast. We can, for most practical purposes, assume that light from the other side of the room takes "no time at all" to reach us. But if we are dealing with the moon or the sun or the stars, the time it takes light to reach us is quite significant. It takes minutes for light to arrive from the sun. It takes years from other stars. It even takes, as you may have noticed, a few seconds for radio waves to travel from a news reporter in South Africa to a satellite and back to a TV broadcast booth in Washington D.C.

So, as we look at the stars, we are stationed at a space/time coordinate gazing into the past. We can calculate the time that something happened to a star, but if someone else at some other point in the universe calculated when that same event happened, would she or he find that it happened at the same time? In a Euclidian universe the answer would be an obvious, "Yes." But Einstein raised for us the novel notion that other geometries apply better to our actual observations. This has turned out to be in accord with the facts--very specific measurable facts like the way the planet Mercury rotates around the sun.

Let us return to this curious notion that two events might be simultaneous to one observer but not to another. Picture two space ships passing by each other with a velocity that is near the speed of light. Suppose that a traveler on one of those ships sees two flashes of light one at each end of his ship. He happens to be sitting in the exact middle of his ship, so the light reaches him from each flash at the same time. The second observer zipping by in the other ship also sees the two flashes of light but the velocity of his spaceship is moving him toward one of the flashes and away from the other flash. So he sees the flash he is moving toward first and the flash he is moving away from later.

The observer in the first ship can explain this discrepancy easily. He says that with respect to these two flashes he is not moving while the other ship is moving relative to these two flashes. But, says Einstein, the observer in the other ship can with equal justification say that he is not moving and that the first ship is moving with respect to him. So the second observer's claim that the flashes are not simultaneous is also correct. The second observer can say that the first observer sees them as simultaneous only because he is moving.

If we could decide which space ship is at rest and which is moving, we could resolve the matter. We could even resolve the matter if we could decide that they were both moving with respect to some fixed medium through which the light flashes were traveling.

Early in the twentieth century, the existence of such a medium (called the ether) was actually assumed by most physicists. This ether had the quality of a fixed Euclidian space through which the waves of light moved. So this ether was a stationary reference point. A couple of men named Michelson and Morley designed a very accurate experiment. Using long vacuum tubes, they measured the speed of light in the direction that the Earth was moving around the sun and compared that with the speed of light when it was moving in a line perpendicular to the earth's movement. The difference in speed would tell them how fast the Earth was moving through the stable medium of the ether. But there was no difference in speed detected. Did this mean that the Earth was the one body in the whole universe that was at rest in the ether? Such an assumption was untenable for a number of reasons, so physical theory was facing an immense puzzle.

Einstein solved this puzzle by looking outside the box of the reigning assumptions. He assumed that every point in the cosmos could be considered at rest--that the laws of nature were such that this strange assumption would hold true. This meant that the two observers on the two space ships were both right. To one the events were simultaneous. To the other they were not. And furthermore it was possible for each of them to calculate how it was for the other if they possessed Einstein's ways of calculating.

Other consequences followed. Space as well as time was seen to be relative to the observer doing the measuring. In our illustration above, if our two observers measure the lengths of their spaceships, they will come up with different lengths. Similarly, the mass of each spaceship will not measure the same for each of these two observers.

All this might be dismissed as mere fantasy, if experiments did not bear this out. Here is a simple experiment now accomplished many times. If we accelerate a proton or some other bit of mass, it becomes harder and harder to accelerate as it approaches the speed of light. Its mass approaches infinity as its velocity approaches the speed of light. This means that no object can travel faster than the speed of light relative to some other object. This also means that the energy we give something when we accelerate it increases its mass. A thrown baseball is heavier than a baseball in the glove, but in this case the increase is so small that we do not notice it. But with faster speeds the effect is noticeable and measurable according to the now familiar formula $E = mc^2$.

While speeding protons might not have convinced some people of the truth of this formula, the explosion of nuclear bombs has been harder to overlook. In these horrific devices, mass is rapidly turned into energy. Mass and energy, it turns out, are the same thing in two different forms. I suppose it may have been difficult, at one time, for human beings to accept that steam and ice were two forms of the same thing. But we can test that easily by putting ice into a skillet. The equivalence of mass and energy can also be shown by doing experiments that are entirely convincing to those who understand those experiments thoroughly.

We do not need to understand all the details of Einstein's physics to grasp that this physics is a better match with the natural world than the previous physics. This new set of fundamental ideas is standing the test of time. Thousands of experiments have confirmed this new direction for physical research. This does not mean that there are not still many puzzles and potential changes in our physical knowledge, but we now live, like it or not, in a post-Einsteinian cosmos. What we thought was the cosmos can no longer be seen as the cosmos by the most observant and thoughtful members of our society.

We Live in a Post-Einsteinian Cosmos

We live within a new vision of the cosmos, and we cannot go back to the old vision. So let us be clear about what we have lost. There is no longer a static space within which we are moving about. Rather, every place in the cosmos is as good as any other place to be the center of the cosmos.

Furthermore, we no longer live in a space that extends endlessly in all directions. Space is now seen as finite but unbounded. This can be a tough idea to get into our Euclidian minds. So let us work into this step by step. Imagine yourself living within a line that is the circumference of a circle. That line is a finite amount, but it does not have an edge: it is unbounded. It goes round and round. Next, imagine yourself living within the two-dimensional surface of a sphere. There is a limited amount of area on that sphere, but there is no edge to it, no boundary. Finally, image yourself living in a three-dimensional space that is similar to that two-dimensional surface of that sphere. We cannot actually picture living within the three-dimensional surface of a fourth dimensional sphere; but if you take that unimaginable picture and then do away with the fourth dimensional sphere, you have the sort of space that post-Einsteinian physics pictures as our actual physical world. This space is limited in amount but unbounded.

The One-Way Street of Time

Another truly strange actuality of our post-Einsteinian cosmos is that the huge galaxies of billions of stars are moving away from one another at tremendous rates of speed. Why? Because the cosmos is expanding. Space itself is growing larger as time passes. Like spots on an expanding balloon, these huge clumps of stars are moving away from one another. Time is affecting space. As time passes, the expanse of space becomes larger. Space is still finite and unbounded, but over time it becomes more and more and still more.

An expanding universe was resisted at first by Einstein himself. But the weight of evidence for an expanding universe is now overwhelming. For good or for ill, this is the current state of our objective knowledge of the physical cosmos.

If we look carefully at this picture of space/time, we see ourselves living in a cosmos that is increasingly strange to our still Euclidian minds. One of those strange consequences is that both time and space had a beginning point. When physicists, in their imaginations, ran time backwards, all these huge galaxies and all this expanding space retreats to a single point, and it does so in a finite period of time--12 to 15 billion years ago. If you ask where that single point is now, you are still thinking of a static Euclidian space. In our actual cosmos, that single point of beginning is now everywhere. That single point has now expanded into every point. Every point in all of space is the place where that single point began. In other words, when space began it was a single point, not a single point in space, but a single point of space. If you contemplate these sentences long enough, perhaps you will see our commonly assumed Euclidian cosmos crumble in your mind.

There are still a few physicists, and a few more metaphysicists, who contend against a singular point of beginning for the cosmos. Some theorize that the cosmos had no beginning but is infinite in time. This view persists in spite of the fact that no evidence has been found for it, and some very basic physical axioms would have to be changed to make this possible. Even on personal preference grounds, why should time be infinite? Do we not find it quite normal to think of time and temporality as almost synonymous with being finite?

Some theorize that the universe is neither expanding nor contracting but only appears to be. A steady-state universe might be empirically true if the dispersed forms of radiant energy were able to become mass again. But most of what we see is hydrogen dispersing radiant energy as it becomes helium. Then as helium and hydrogen join to become other elements more radiant energy is dispersed. Only rarely do we see radiant energy returning to its more organized forms. And when we do see radiant energy becoming mass, it forms both matter and anti-matter. So no net gain in regular mass can take place in this manner because as soon as the anti-matter encounters regular matter, the atoms annihilate one another and return to radiant energy.

Overall, the cosmos appears to be a one-way movement from being tightly wound to unwinding, from intense temperature to little or no temperature at all. The cosmos is like a jar of hot water in an ice box. The heat is moving from the jar to the entire ice box, and the heat does not move back into the jar. You might say that the probability of heat moving out of the ice box back into the jar is only one chance in a number approaching infinity. This analogy holds for the cosmos; as time passes the overall intensity lessens. And this means that the cosmos had a beginning in which it was maximally intense and will have an ending which is minimally intense. This is sometimes called the second law of thermodynamics.

This vision of the cosmos need not be seen as one of horrifying gloom and doom, it is just another statement that the cosmos is finite. Furthermore, on a local scale it is possible for there to be an increase in energy and organization. Every living organism is a good example of this. A living organism can take energy from the decaying cosmos and thereby increase its own energy and organization. That is what we do when we eat food. We take energy from the decaying food to organize and to energize our bodies. If we could not find some sort of food which would decay, we could not do this. Similarly, in the big picture, the decaying cosmos is our source of energy.

This dynamic of decay becoming supply is true for a star. A star is taking its energy from the decaying cosmos. The mysterious power of gravitation pulls together bits of hydrogen that under gigantic pressures fuse into helium which gives off radiant energy. Strange as this may seem, helium of atomic weight four while being complexly organized of four simple hydrogen atoms has a lower energy state than hydrogen. In other words, hydrogen burns to become helium. Similarly, helium and hydrogen, in the gravitational pressures of huge stars and in the explosions of supernova, burn into the other less energetic elements. The element of iron might be said to be pure ash. It appears to have virtually no capacity to burn. It just sinks to the center of stars and planets and forms an inert core. For a star, iron is not good to eat, but hydrogen and helium are yummy.

But iron and the other waste products of a star are food for the human body. And in the end our waste products and our bodies become food for something else.

So back to our overall image of time. Time is a one-way street. In the beginning the cosmos was wound up into a very tight sort of organization that is now unwinding through stages of disorganization that do not repeat themselves. At its beginning point, the universe was at its

maximum temperature, and it is now cooling off toward its minimum temperature. This is the overall picture. In the midst of this overall running down, stars heat up temporarily. Biological forms evolve and thrive temporarily. But in the overall picture the cosmos is running out of steam.

This saddens some physicists and metaphysicists. Some have sought to find evidence that the universe will rebound, will after a long expansion begin a long contraction that returns to its hot beginning. But for living forms this picture is not really more optimistic. And as yet there is no evidence for this big-crunch scenario.

Perhaps our recurring longing for an infinite universe is consistent with our longing to return to Euclid's simple geometry. A line that extends infinitely into the past and into the future is consistent with that geometry. A line of time that ends at some point in the past--a past moment that also means the origin of space--implies a non-Euclidian geometry. Such a geometry is less familiar to our thinking minds, and we want our easiest thinking and the cosmos to correspond. We may also resent the implication that our minds are finite, and that reality as a whole is beyond our understanding.

The Metaphysics of post-Einsteinian Physics

The universe according to post-Einsteinian physics is not only strange to our Euclidian assumptions, but we keep discovering more and more strangeness in this strange cosmos. We don't really know where all this will end up. Our somewhat conflicting theories will either become more consistent or they won't. Our somewhat complex theories will become more simple and beautiful or they won't. Physics is not a static body of knowledge, but an ever changing cultural consensus based on empirical verifications within an overall cosmos in which more learning is always possible.

We can be absolutely certain, however, that we are not going back to Newtonian physics or to the view that Euclidian geometry is a physical fit. Some have leaped to the conclusion that Einstein's big shift in physical axioms gives us permission to harbor any view of the cosmos that we want--that there is no such thing as objective truth any longer. But that is not Einstein's view nor mine. I am convinced that we must defend objective knowledge from the super-relativism implied in that view.

Relativity as an Objective Truth

The basic meaning of relativity in contemporary physics is that we cannot go back to the view that there is for human beings some absolute perspective on space and time and other realities. We humans do not dwell within an independent mental space--some sort of mental "over-here" from which we can view the cosmos as "over there." The cosmos is not like some picture on a wall or some object in our hands. This extreme definition of "objectivity" has been rejected by Einsteinian physics. Rather, we are now stuck with the realization that we observe the cosmos from some specific coordinate in space/time. From this perspective, we can see that reality looks different from significantly different space/time coordinates. This sort of relativity is now part of our objective knowledge.

"Einsteinian relativity" does not mean that any opinion about the cosmos is as good as any other. Objective knowledge is still the content of physics. What we can conclude, however, through our experience of this revolution in physical axioms, is that our minds are finite. Our minds do not dwell in some absolute realm of infinite knowledge. Our entire beings, minds and

all, have been thrown into existence at a particular place and time. This well-formulated assumption is now grounded in abundant factual experience. In our objective knowledge, we must observe the cosmos with finite minds from some specific, finite space/time coordinate.

Indeterminacy as an Objective Truth

Post-Einsteinian physics has also included new discoveries in the infinitesimal realm. These discoveries are commonly called "quantum mechanics." Quantum mechanics has intensified the evidence that our reasoning minds are finite--that we are severely limited in our capacities to objectively understand the cosmos of which we are a part. Physicists have found that there is a limit to the accuracy with which we can measure space and time. Because we must use light or some other communication medium with which to observe things, we meet a limit when our medium of observation significantly changes what we are observing. We are stuck with processes of observing that are part of the cosmos that we are observing. And these interactions of our observing methods hide as well as reveal what is going on.

For example, we have discovered that light itself comes in small packets which are called photons. These photons in some ways behave like a series of bullets fired from a gun. But in other ways light behaves like waves moving through water. So which is it, bullets or waves? Why don't we just look and see? We have to use light to see light, and the interactions of these photons changes what we are looking at. We cannot see what light is. Our honestly inquiring minds finds that light is both bullets and waves, which means it is neither bullets nor waves. This is the strange truth: light in its full actuality is permanently unimaginable to the human mind. It is understandable that some still resist this humbling conclusion.

Most physicists are reconciled with imagining light as operating sometimes like waves and sometimes like bullets. And for any conceivable practical purpose, this fractured theory does not seem to matter. Physicists can still do the math and predict what we want to predict.

Nevertheless, we metaphysicists who wish to ask questions about the nature of the human mind and about the nature of objective knowledge may feel let down. Or to put the situation positively, we simply have to face the fact that physicists have concluded that we cannot know, except in a paradoxical fashion, what is going on with electromagnetic radiation, with electrons, and with a number of other entities that act like both waves and particles. We, humanity, have bumped up against a stern unrelenting limit on the accuracy with which we can measure very small bits of space or time and very small bits of mass and energy. And what does this mean? It means that our human capacities for observing the natural world are finite. It means that we are constitutionally incapable of even imagining fully what physical reality is. This may be frustrating to those of us who want to have some sort of absolute knowledge. But if we can be content with finitude, then we can relax with this situation. We are simply experiencing at the very core of our most rational discipline of science that nature does not conform to human rationality. Nature is mysterious. Why need this be such a big surprise?

This "indeterminacy," as it is called by physicists, does not prove that there is no such thing as objective knowledge. Rather, indeterminacy itself is part of the objective knowledge of contemporary physics. This does not mean that we can know nothing at all; it just means that we can never know many things as fully as we might like to know them.

Mysteriousness and the Finitude of the Human Mind

The physicist, Richard Feynman, in one of his colorful lectures mentioned a specific instance in current physical research where three different theoretical pictures yield the same

mathematical formulas and describe the same phenomena. We don't know, he says, which picture is best. In future research, one of these theories may prove better for understanding still other matters, and so two of these three theories may drop out of use. Maybe this will happen, he says, or perhaps we will remain stuck with this bit of theoretical ugliness forever. Simplicity, beauty, and consistency are values in physical research, but the cosmos is often experienced as complex, ugly, and chaotic as well as simple, beautiful, and consistently ordered.

Such theoretical inconsistencies tell us once again that the human mind is finite and that further mysteries will be an unending part of our research into the nature of the physical world.

Our awareness of the finitude of the human mind is also our awareness of the infinite mysteriousness of the actuality which surrounds us. Mysteriousness penetrates through and through all our knowledge. In spite of all our progress in the physical sciences, we still do not know why an object set in motion continues to coast unless its motion is altered by some outside force. We know that bodies do coast, but we don't know why. I have heard it said that bodies coast because coasting mirrors the infinite changlessness that undergirds all things. That is interesting poetry, but it is only poetry. It is not objective scientific knowledge. Scientific knowledge does not know why things coast.

Similarly, though our wondrous post-Einsteinian physics can describe in remarkable detail how gravity works, we don't know why there is such a thing as gravity in the first place. We don't even know how it relates to all the other basic forces. With Einstein's help, we can describe gravity in the following colorful way: gravity is the shape of time and space in the presence of mass so as to incline mass to come together into a spinning semi-sphere. Yet we have no idea why this happens. Some, in their quest for an answer to the why of gravity have said that gravity exists because the cosmos prefers gathering to scattering. This is also poetry or myth, and this myth is only partly true. For the cosmos also appears to be scattering its galaxies to a wide-spread vacuous destiny. Furthermore, light and other electromagnetic energies, once they have escaped from some massive body, move ceaselessly away from their source. We myth-makers might suggest that the movement of light is the cosmos communicating with all its scattering parts. But whatever myths we create, we still don't actually know why any of this happens or what any of this is all about. There is no scientific explanation that tells us why gravity exists, why the universe expands, why light shoots at a finite rate of speed throughout this gravity-shaped and expanding cosmos. All these things and a very long list of other physical phenomena baffle the wondering minds of humanity.

Furthermore, these mysteries encountered through the discipline of physics are only part of the mysteriousness we experience in the entire range of objective knowledge. Our objective knowledge of space/time, mass/energy, and all the elemental forces and interactions among these primal actualities is just the foundational layer of our scientific knowledge. Upon this foundation are built other layers of objective knowledge, the sciences of biology, the sciences of animal and human psyches, the sciences of human society, the scientific element in the artful writing of history, and more. We can picture these various scientific pursuits as layers, because each layer, while dependent upon the foundational layer of physics, is using concepts and realms of experience with which physics does not deal.

For example, when we move from the layer of physics to the layer of biology we stumble across a border called "life." We are forced to ask how "life," "aliveness," or "being animate" is distinguished from "being inanimate," "material," or "dead." While living organisms are composed of the same stuff with which physics deals, the scientific study we call "biology" has something on its hands not dealt with in physics. The physical components of biological beings obey all the physical laws, and no exceptions to this have been found. But living forms include

an actuality that no physical law can explain. All our attempts to explain life in terms of the complex chemical processes of physics are unsatisfying. Nevertheless, the hope of finding such an explanation still persists among many biologists and many members of modern culture. Yet the actual state of our objective knowledge is that we have no indication that further clarifications in physics or in our objective knowledge of living organisms will tell us in physical terms what life actually is. Just as we do not know why objects coast, we do not know why organisms live.

To define "life" at all is a challenge. As a beginning, I like this definition: a living being is any being which inwardly processes its encounters and creatively responds to them. An atom or a molecule does not do this--its encounters are not inwardly processed; its responses are not creative. No decisions are made by an atom. A photon may strike an atom causing it to change in an unpredictable fashion, but all the various ways in which that atom might change are predictable as fixed statistical probabilities. An amoeba, however, can make responses that are not even statistically predictable. All attempts to explain the responses of living forms as either random or mechanical are strained explanations. Why is this so? I believe that it is so because living beings make choices, and choices are not something that objective knowledge can measure.

As a further example of this dilemma, the evolution of new species of life is only partly explained in terms of random mutations that are then advantaged by their environments. Each species is constantly making choices for locations in which to live and for its customary practices for living there. These choices also affect biological evolution. When we look at the entire sweep of the story of life from single-celled beings to the most complex animals, explaining all of this with only the principle of randomness and environmental determinism is a huge stretch.

Most biologists have attempted to pattern their work after physics, but they have never found a way to make livingness explainable from the foundational knowledge of physics. We can dismantle a living being into its molecules and atoms, but we cannot put a living being together. We may never be able to do this. Furthermore, we do not as yet know how some gathering of complex molecules became the first living being. And we may never know.

Why should we be startled by the prospect that aliveness may never be explained from a physical standpoint? Why not simply admit that life is another mystery, another dynamic where the finite mind of humanity meets the unfathomable? This admission is not a diminishment of our objective knowledge in physics or in biology. We can still be clear that physics provides us with foundational knowledge which living forms cannot violate. We are only noticing that life is something more--that there is a fundamental discontinuity between alive and dead.

Similarly, when we enter into a scientific study of human intelligence, language, art, culture, and other elemental potentialities of the human species, we need not suppose that the objective knowledge of biology and physics will suffice for understanding these things. We again enter a new layer of knowledge construction. And in this layer, further mystery is manifest. Our objective knowledge of these uniquely human dynamics rests upon the foundational layers of our biological and physical objective knowledge, but these layers do not explain one another. And these rational disconnects need not bother us if we do not insist that our minds are capable of fully knowing reality. If our minds are indeed finite and reality is indeed beyond our mental limits, then no amount of further knowledge will ever overcome all the inconsistencies and disjointedness in our knowledge. As numerous research scientists have confessed, "the more we know, the more we know we don't know."

The Validity of our Finite Objective Knowledge

Does the finitude of our thinking minds and the finite quality of all our current and future states of objective knowledge mean that we do not have valid objective knowledge? No, objective knowledge need not be a matter of all or nothing. We can have objective knowledge as a reality that exists somewhere between all and nothing. Objective knowledge is indeed something we count on for the practical living of our lives. Objective knowledge is a guide that delivers us from some of our crassest illusions and superstitions. A love of realism includes honoring our objective knowledge and taking responsibility for integrating it into the living of our lives. We know we know what we know even if we also know that we don't know everything. We know that much of what we know will one day change into an expanded knowing, but still we are stuck with knowing what we now know. This is the nature of objective knowledge. Objective knowledge is limited, approximate, and changing; and yet it is our objective knowledge.

I say "**OUR**" objective knowledge because we have this knowledge in common with our entire culture. Objective knowledge, however, is not objectively true merely because our culture accepts it as true. Our culture accepts it (or is in the process of accepting it) because our culture has accumulated the empirical experience that supports this objective knowledge. Our cultural situation is somewhat like our having to observe physical reality from some particular coordinate in space/time; we have to observe reality from inside a particular human culture. We cannot escape from being within some overall culture with all its gifts and all its inadequacies. Our objective knowledge is one of those cultural gifts. It is true that this gift of objective knowledge is limited, approximate, and changing; but it is still a great gift. Without it our lives could not function.

But however much we value our objective knowledge, we need to remain aware that our objective knowledge cannot encompass the Infinite Wholeness of Mysterious Reality. Why? Because our objective knowledge and our entire culture are finite realities. Our brains and our minds are finite. Our brains and our inward minds do not poke up into some infinite realm of truth. The deeper we experience the finitude of our minds, the deeper we experience the Mysterious Wholeness in which we dwell. And even this Mysterious Wholeness is not experienced in a vacuum; we experience Mysteriousness from within the current objective knowledge of our culture. Without our current objective knowledge, we would not be experiencing Mysteriousness in the ways in which we are experiencing it. We would be experiencing Mysteriousness in some other ways. We live in the space/time location of our culture--which culture is being shaped by the post-Einsteinian vision of space/time. We know that our physics is only an approximation of Reality, but we have no other place from which to view the Mysterious Wholeness we are approximating.

Mysteriousness, God, and other Metaphors

Many have asked if the "Big Bang," that great flaring forth of space/time from a singular beginning point, supports the existence of a Creator. No, it does not. The very notion of a Creator is part of a story that includes a second realm which physics does not assume. In this two-realm, human-made story, a Creator is pictured as living in this other-than-natural realm creating the natural realm out of nothing . This is a story. This is a myth. It is not a scientific hypothesis, and its truth or falsehood cannot be tested by scientific means. If we ask contemporary physicists about what existed before the great flaring forth, we might receive smiles and blank looks. For how can we talk scientifically, or even philosophically, about what was before the dawn of time? (This would mean speaking of before there was a "before" or an

"after.") And how can we talk about what existed before anything existed? Before the emergence of space/time there was just (what shall we say?) "Mysteriousness." Before the "Big Bang" there was just (what shall we say?) "Silence." Physics cannot say more than this. Our objective knowledge does not tell us whether this Mysteriousness can best be imaged as Many Gods or One God or Spontaneous Regeneration or Grand Purpose or Hidden Design or any other metaphor that human imagination might devise.

"Sheer Accident" is a metaphor preferred by many. But "Sheer Accident" or "Chance" is not an objective explanation of the cosmos. Like all the other possible metaphors it is a human "belief," a "faith," a "decisional attitude" toward Infinite Mysteriousness. Furthermore, those who "believe" in "Sheer Accident" compose their own mythologies in order to tell such believing minds how it happened that the cosmos got wound up so it could do its current unwinding. Such myths are a felt need because our objective knowledge of statistical probabilities is staggered by the minute probability of the existing cosmos ever happening. So some of those who "believe" in "Sheer Accident" have constructed stories (myths) about the existence of an infinite number of universes. We just happened to occupy the one that worked out this way. We don't experience these other universes, so this story goes, because we are living in the one that came up this way. Telling this story is somewhat like saying that a deck of cards, if shuffled enough times, will finally come up with all four suits in Ace through King order. With enough tries, anything can be the case.

Others find "Sheer Accident" a belief that strains their credulity, so they have preferred a belief in "Grand Purpose" or "Hidden Design." But these are also metaphors created by the human imagination: they are human-created stories or myths which reach out to catch the uncatchable Infinite Mysteriousness in their net. These "believers" also write myths. These myths begin by pointing out the objective truth that the human mind does indeed experience order in the cosmos. Then these myths leap into the "belief" that the invisible Wholeness is a "Design" that we have yet to know. Yet the assumed Design, since it is invisible, is currently being experienced by the finite mind of humanity as chaos. This is the harsh truth of our actual experience: we see no less chaos than we do order. Chaos is that part of Infinite Mysteriousness that the human mind has not ordered. Order is that part of the Infinite Mysteriousness that the human mind has ordered. No experience can support the leap from our experience of order and chaos to a belief in a Final Order, a Grand Purpose, or a Hidden Design. These beliefs can never be a hypothesis testable by the scientific method. Each of these grand terms are expressions of a leap of faith, a story, a myth, a poetry that goes beyond our objective knowledge.

Humans can certainly be thankful that the cosmos is orderly enough that humanity can know and predict many things well enough to survive. Indeed, our species must surely have evolved its order-perceiving minds within an environment that rewarded orderly reflection with increased survival potentials. We may also wish to give thanks for the sheer beauty of the orderliness we see. But let us stare frankly at this sober truth: orderliness simply refers to that part of the cosmos that the human mind can order. Chaos describes the rest. Our objective knowledge is limited knowledge surrounded by chaos. No more can be said than this without entering into the arena of poetry, myth, faith, or belief--into a mode of reflection that is something more than objective science.

So what is a theologian to do with post-Einsteinian physics? Is contemporary physics an enemy or a friend to theology? If the word "God" is used as a hypothesis that is supposed to make sense of something in the physical world, then physics will be in serious conflict with that theology. But if the word "God" is just a name for the attitude of "Yes" toward Infinite Mysteriousness, then the objective knowledge of physics will be an ally. Consider this formula: God equals Mystery plus Yes. If I accept this formula, I am using the word "God" to mean a

deep trust of Mysterious Reality--visible and invisible, known and unknown. I am saying "Yes" to the mystery of my birth, "Yes" to the mystery of my death, and "Yes" to every mystery between birth and death as well as before and after. If this is the way I am using the word "God," then there can be no conflict between my theology and the objective knowledge of physics or any other objective knowledge. Indeed, wherever the development of objective knowledge may go in the future, it will simply expand my culture's experience of the Mysteriousness that I am calling "God."