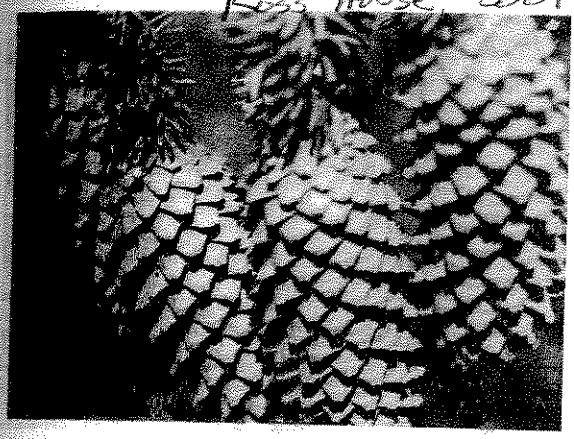
Mathematics: Is God silent?
by James Nickel
Ross House, 2001



6: Why Does Mathematics Work?

The eternal mystery of the world is its comprehensibility.[1]

Albert Einstein

In this chapter, the author would like to show that, when a person begins with the idea that the reason of man is autonomous in mathematics, then, when it comes to the comprehensible applicability of mathematics to reality, words like "mystery" and "incredible" appear all over the place.

6.1 The Myth of Neutrality

Early in the 20th century, Bertrand Russell reacted to the paradoxes of set theory with this statement: "Mathematics is the subject in which we never know what we are talking about, nor whether what we are saying is true."[2] Then, using the medium of logic, Russell and Whitehead tried to build a secure and indubitable foundation for mathematics. Gödel's results stopped them dead in their tracks. Toward the end of his life, Russell evaluated his efforts:

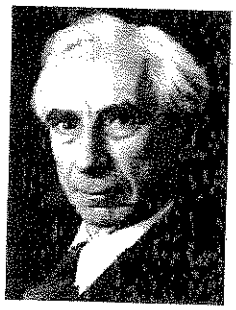


Figure 99: Bertrand Russell

> I wanted certainty in the kind of way in which people want religious faith. I thought certainty is more likely to be found in mathematics than elsewhere. But I discovered that many mathematical demonstrations, which my teachers expected me to accept, were full of fallacies, and that, if certainty were indeed discoverable in mathematics, it would be in a new field of mathematics, with more solid foundations than those that had hitherto been thought secure. But as the work proceeded, I was continually

[1] Albert Einstein, *Out of My Later Years* (New York: Citadel Press, [1950, 1956, 1984] 1991), p. 61.
[2] Bertrand Russell, "Recent Work on the Principles of Mathematics," *The International Monthly*, 4 (1901), 84.

reminded of the fable about the elephant and the tortoise. Having constructed an elephant upon which the mathematical world could rest, I found the elephant tottering, and proceeded to construct a tortoise to keep the elephant from falling. But the tortoise was no more secure than the elephant, and after some twenty years of very arduous toil, I came to the conclusion that there was nothing more that I could do in the way of making mathematical knowledge indubitable.[3]

Russell's perspective of life and mathematics revealed a clear presuppositional stance:

> Man is the product of causes which had no prevision of the end they were achieving; that his origin, his growth, his hopes and fears, his loves and his beliefs, are but the outcome of accidental collocations of atoms; that no fire, no heroism, no intensity of thought and feeling, can preserve an individual life beyond the grave; that all the labor of the ages, all the devotion, all the noonday brightness of human genius, are destined to extinction in the vast death of the solar system, and that the whole temple of man's achievement must inevitably be buried beneath the debris of a universe in ruins – all these things, if not quite beyond dispute, are yet so nearly certain, that no philosophy which rejects them can hope to stand. Only within the scaffolding of these truths, only on the firm foundation of unyielding despair, can the soul's habitation henceforth be safely built.[4]

As we have surveyed the history of mathematics, we have noticed that what an individual or culture believes concerning the origin, purpose, and destiny of the cosmos affects the way mathematics is viewed and ultimately, the way mathematics progresses. In the words of Oswald Spengler, "The style of any mathematic which comes into being ... depends wholly on the culture in which it is rooted, the sort of mankind it is that ponders it."[5]

Mathematics is not a neutral discipline; it is always linked with presuppositions. In fact, in its presuppositional base, mathematics either thrives or dies. In the civilizations of antiquity, we have seen that mathematics progressed for a few centuries, then stagnated due to a false worldview. We have also noted the great creative mathematical stirrings that took place in a culture steeped in the biblical worldview. Today, the majority of mathematicians and scientists philosophically deny the worldview that birthed modern science. Given this stance, what is the present condition of mathematics and where will it end? Will it eventually exhaust itself?

Francis Schaeffer observes that "the world view determines the direction such creative stirrings will take, and how – and whether the stirrings will con-

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[3]Russell, *The Autobiography of Bertrand Russell*, 3:220.
[4]Bertrand Russell, "A Free Man's Worship" (1903) *Mysticism and Logic, and Other Essays* (London: Longmans, Green & Co., 1921), pp. 47-48.
[5]Spengler, 4:2318.

tinue or dry up."[6] It is a fact that, in the 20th century, more work has been done in mathematics than all other centuries combined.[7] If mathematics should exhaust itself in a culture steeped in humanism, then why all this activity? Schaeffer explains, "Later, when the Christian base was lost, a tradition and momentum had been set in motion, and the pragmatic necessity of technology, and even control by the state, drives science on, but … with a subtle yet important change in emphasis."[8]

That change in emphasis, from Christianity to humanism, has serious ramifications. Stanley L. Jaki makes this clear as he comments on the philosophical movements in the 18th and 19th centuries:

> The next two centuries saw the rise of philosophical movements, all hostile to natural theology. Whatever their lip service to science, they all posed a threat to it. The blows they aimed at man's knowledge of God were as many blows at knowledge, at science, and at the rationality of the universe.[9]

It is extremely important to note that many scientists today believe in a cosmology that posits an "oscillating" universe. Through observational astronomy, distant galaxies are known to be receding from ours, the Milky Way, at great speed. In fact, the farther these galaxies are away from ours, the greater is their speed away from us.[10] To many astronomers, this indicates that the universe is "breathing out." If the universe is exhaling, there had to be a point in time when this "breathing" began. At one time in our distant past, say these astronomers, all the matter of the universe found itself concentrated in one extremely dense atom. Then an explosion occurred, called the Big Bang, and the elements of the universe galloped off into space. Now, and it is essential to note this, these astronomers do not conclude their theory with a universe "breathing" out. If the universe is now exhaling, it will need to "inhale" again. That is, the elements of the universe will eventually "breathe in" coming together again

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[6]Schaeffer, *How Should We Then Live? The Rise and Decline of Western Thought and Culture*, p. 133.

[7]See Keith Devlin, *Mathematics: The New Golden Age* (London: Penguin Books, 1988). Devlin points out that in the year 1900, all the world's mathematical knowledge could be compiled in about eighty books. One hundred years later, one hundred thousand books would be needed to store that knowledge. The validity of this mathematical storehouse of knowledge to the realm of physical science is questionable, however. Like the accomplishments of the Alexandrian Greeks, this repository may just be a "mass of detail without focus." See the chapter entitled "The Isolation of Mathematics" in Kline, *The Loss of Certainty*, pp. 278-306. In the words of John von Neumann (see section 5.5), this mathematical knowledge, due to abstract inbreeding, may just be a "multitude of insignificant branches … a disorganized mass of details and complexities."

[8]Schaeffer, *How Should We Then Live? The Rise and Decline of Western Thought and Culture*, p. 134.

[9]Jaki, *The Road of Science and the Ways to God*, p. 160.

[10]These ideas are based upon the theory of spectroscopic red-shift. This is a controversial topic in the scientific community and it illustrates how scientists read their cosmogonical and teleological preconceptions into their observations. For further detail, see Paul M. Steidl, *The Earth, the Stars and the Bible* (Phillipsburg: Presbyterian and Reformed, 1979), pp. 211-218. For an interesting and fascinating attempt to analyze spectroscopic red-shift from a biblical cosmogonic perspective, see D. Russell Humphreys, *Starlight and Time: Solving the Puzzle of Distant Starlight in a Young Universe* (Colorado Springs: Master Books, 1994).

into one extremely dense atom. This is what "oscillating" universe means. This idea is a mirror image of the ancient eternal cycle theory.

Stanley L. Jaki sees the theory of the oscillating universe as the gravest perplexity of the modern, scientific world. He says:

> The very roots of that perplexity form a mirror-image of the age-old need to make a choice between two ultimate alternatives: faith in the Creator and in a creation once-and-for-all, or surrender to the treadmill of eternal cycles. Such should indeed be the case, as the present is always a child of the past. The present and past of scientific history tell the very same lesson. It is the indispensability of a firm faith in the only lasting source of rationality and confidence, the Maker of heaven and earth, of all things visible and invisible.[11]

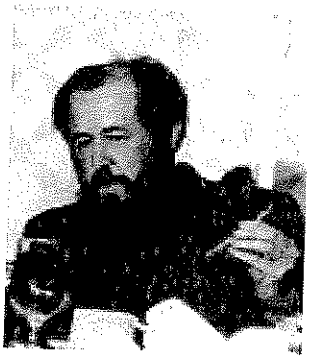

Figure 100: Aleksandr Solzhenitsyn

If Western man continues to aim his metaphysical, epistemological, and ethical blows at the revelation of God in His word and in His works, Western civilization will eventually stagnate and die just like the cultures of antiquity. This fact has been graphically portrayed to the West through the articulate and heart-rending words of the Russian exile and one-time mathematics/physics teacher, Aleksandr Solzhenitsyn (1918-).[12] In 1946, responding to the appalling devastation (nuclear and otherwise) of World War II, Albert Einstein (1879-1955) reflected, "It is easier to denature plutonium than it is to denature the evil spirit of man."[13] In 1948, Omar Bradley (1893-1981), famed World War II general, scrutinized both the scientific advances and ethical forfeitures of the 20th century: "We have grasped the mystery of the atom and we rejected the Sermon on the Mount. Ours is a world of nuclear giants and ethical infants."[14] For Bertrand Russell, it was the likely prospect of nuclear holocaust that caused him to add a disclaimer to his scientific ethical manifesto – his "firm foundation of unyielding despair centered on a accidental collocations of atoms" – made fifty years earlier. In 1950, he reluctantly admitted:

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[11]Jaki, *Science and Creation: From Eternal Cycles to an Oscillating Universe*, p. 357.

[12]See Alexandr Solzhenitsyn, "Men Have Forgotten God," The Templeton Address (1983), *National Review*, July 22, 1983. See also his commencement address given at Harvard University on June 8, 1978 entitled "A World Split Apart" (available from many sources).

[13]Albert Einstein, from an interview with Michael Amrine, *The New York Times Magazine*, June 23, 1946, p. 42.

[14]General Bradley said this in Boston on November 10, 1948. Cited in Jaki, *The Road of Science and the Ways to God*, p. 304.

> The root of the matter is a very simple and old-fashioned thing, a thing so simple that I am almost ashamed to mention it, for fear of the derisive smile with which wise cynics will greet my words. The thing I mean – please forgive me for mentioning it, is love, Christian love or compassion. If you feel this, you have a motive for existence, a guide for action, a reason for courage, an imperative necessity for intellectual honesty.[15]

In spite of its metaphysical, epistemological, and ethical trauma, modern science and mathematics drive on, either in ignorance or in blunt rejection of the biblical foundations that engendered its viable birth. The low-octane fuel of pragmatic necessity fuels science. Mathematics is driven by the ivory tower of abstract analysis.[16] In spite of the imposing discoveries made by modern mathematicians and in spite of the voluminous mathematical activity in the past one hundred years, the price tag of modernity's ethical relativism will be paid. In part, the price is being paid now if we discerningly "understand the times" (I Chronicles 12:32). Stanley L. Jaki comments on these themes:

> To cultivate a science which has grown, in virtue of a viable birth, into a robust being, an explicit faith in Creation is not necessary. But since any such being lives in terms of the logic of its conception and birth, scientific blind alleys immersed in philosophical darkness will be in store for those who chart, intentionally or not, avenues whose sense is diametrically opposed to the most creative innovation in human thought, the Christian doctrine of creation of all out of nothing in the Beginning.[17]

Returning to presuppositions, in the philosophy of mathematics, they can be based either upon the autonomy of man or in the biblical revelation of the sovereign, Creator God. A world of difference separates the two. One believes that all things happen by chance, the other by design. One, using the words of Bertrand Russell, is the philosophy of empty despair and the other the dynamic of living certainty. These two presuppositional camps will be delineated as we inspect the statements made by 20th century mathematicians and scientists.

6.2 THE STATE OF THE ART

6.2.1 PREESTABLISHED HARMONY

Sir James Jeans (1877-1946), renowned British mathematician and scientist, said in 1930, "The universe shows evidence of a designing or controlling power that has something in common with our own mathematical minds … the ten-

[15]Bertrand Russell, *The Impact of Science on Society* (New York: Columbia University Press, 1951), p. 59.

[16]That some of this abstract analysis in mathematics may sometime, in the future, relate to the physical world is not denied. When this happens, it happens in spite of the philosophy that motivates this type of study, not because of it (and due to God's common grace). The author does not relegate pure mathematics to some Satan-inspired realm of darkness. The danger in absolutizing pure mathematics is in separating it from its life-blood; i.e., God's variegated creation.

[17]Jaki, *Science and Creation: From Eternal Cycles to an Oscillating Universe*, pp. 366-367.

dency to think in a way which, for want of a better word, we describe as mathematical."[18] He adds:

> The essential fact is simply that all the pictures which science now draws of nature, and which alone seem capable of according with observational fact, are *mathematical* pictures.... Nature seems very conversant with the rules of pure mathematics.... In any event it can hardly be disputed that nature and our conscious mathematical minds work according to the same laws.[19]

Figure 101: Sir James Jeans

Since Jeans perceived an ingrained harmony between mathematics and nature, he concluded that only a mathematician could understand the essential workings of the universe. It is this alliance of mathematics and nature that inspired him to say, "... the Great Architect of the Universe now begins to appear as a pure mathematician."[20]

Pierre Duhem agreed with Jeans by observing that "it is impossible for us to believe that this order and this organization produced by theory are not the reflected image of a real order and organization."[21]

Referring to the givens of nature, Hermann Weyl saw in mathematics "a wonderful harmony between the given on one hand and reason on the other."[22]

Max Planck (1858-1947), a German theoretical physicist, laid the foundations for the development of the quantum theory, a theory which revolutionized physics. Near the end of his life, he said:

> What has led me to science and made me since youth enthusiastic for it is the not at all obvious fact that the laws of our thoughts coincide with the regularity of the flow of impressions which we receive from the external world, [and] that it is

Figure 102: Max Planck

[18]James Jeans, *The Mysterious Universe* (New York: Macmillan, 1930), p. 149.
[19]*Ibid.*, p. 127.
[20]*Ibid.*, p. 144. For an analysis of this statement, "the Great Architect of the Universe appears to be a pure mathematician," see section 6.10.
[21]Pierre Duhem, *The Aim and Structure of Physical Theory*, trans. Philip P. Weiner (Princeton: Princeton University Press, 1954), p. 26.
[22]Weyl, *Philosophy of Mathematics*, p. 69.

> therefore possible for man to reach conclusions through pure speculation about those regularities. Here it is of essential significance that the external world represents something independent of us, something absolute which we confront, and the search for the laws valid for this absolute appeared to me the most beautiful scientific task in life.[23]

Albert Einstein (1879-1955) refined Newton's model of the universe with his special and general relativity theories. Some understand Einstein's relativity theory as a total rejection of the ordered time and space of Newtonian mechanics.[24] Remember Alexander Pope's epitaph on Newton,

Nature and Nature's laws lay hid in night;
God said, "Let Newton be!" and all was light.

In response to Einstein's discoveries, Sir John Collings Squire added,

It did not last: the Devil howling "Ho!
Let Einstein be!" restored the status quo.

Experimentally, Einstein's theories were limited in application to the realms of the very fast (e.g., the speed of light) and the very large (e.g., the entire universe). Everywhere else, including flying in an airplane and sending men to the moon, Einstein's theories paralleled those forecasted by Newtonian mechanics.

Although Einstein talked about a "God who does not play dice," he remained an agnostic most of his life.[25] Stanley L. Jaki remarks that in Einstein's "cosmic religion" there was "no room for creation or Creator."[26] Einstein himself defined his conception of God as follows:

> Certain it is that a conviction, akin to religious feeling, of the rationality or intelligibility of the world lies behind all scientific work of a higher order. This firm belief, a belief bound up with deep feeling, in a superior mind that reveals itself in the world of experience, represents my conception of God.[27]

He then admitted that his conception of God, the superior mind, was pantheistic in nature.[28] When it came to his scientific and mathematical work, he

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[23]Max Planck, "Wissenschaftliche Selbstbiographie," *Physikalische Abhandlungen*, 3 (1948), 374.

[24]Einstein replaced the metaphysical absolutes of time and space (they are relative to one's position) with the material absolute of the speed of light. For a study of the impact of Einstein's thought (more indirectly than directly) on culture, see the chapter entitled "A Relativistic World" in Paul Johnson, *Modern Times: The World from the Twenties to the Nineties*, pp. 1-48.

[25]Einstein may have talked about God, but biblical revelation did not provide him with any direction and purpose in life. To him, "to ponder interminably over the reason for one's own existence or the meaning of life in general seems to me, from an objective point of view, to be sheer folly." Albert Einstein, *What I Believe* (London: George Allen & Unwin, 1966), p. 27.

[26]Stanley L. Jaki, *Cosmos and Creator*, p. 4.

[27]Einstein, *Essays in Science*, p. 11.

[28]*Ibid.* That Einstein, a Jew, would freely embrace pantheism is explainable only when one recognizes the difference between Christian monotheism and Jewish (also Muslim) monotheism. In Christian monotheism, Christ is the only-begotten (the *monogenes*) of the Father (see section 3.3 and John 1:14). In Judaism (as in Islam) there is no place for the *monogenes* to reside in a person (i.e., Je-

placed his faith in, using the words of Leibniz, a "preestablished harmony in the universe."[29] To him, as illustrated by the above quotation, God was simply a name for this principle of harmony in the universe.

Einstein's passion for order is revealed in the following legend told by Otto Neugebauer.[30] When Einstein was a youth, his parents were worried about him because he did not speak at all. Finally, one day at supper, he broke the silence saying, "Die Suppe ist zu heiss" (The soup is too hot). Greatly relieved, his parents asked him why he had not spoken up to that time. He replied, "Bisher war alles in ordnung" (Until now everything was in order).

According to Stanley L. Jaki "... the mathematicians and especially the geometry that the scientists of Galileo's time held in such high esteem was not considered by them a free creation of mind but rather a pattern to be learned from observation of the actual contours of nature."[31] This statement reflects the viewpoints of all of the above scientists; a viewpoint that presupposes mathematics to be a splendid tool that enables man to discover order in a preestablished universe. This assumption is in agreement with biblical revelation, even though most, if not all, of these men would not overtly align themselves with the Christian faith. Unfortunately, their belief is the minority opinion because most modern mathematicians and scientists understand mathematics to be, not a tool, but a divining rod.

6.2.2 "THE FOOTPRINT IS OUR OWN"

John W. N. Sullivan (1886-1937), who wrote many interpretive works on science, expressed the majority opinion by saying:

> And it seems that the mathematician, in creating his art, is exhibiting that movement of our minds that has created the spatio-temporal material universe we know ... The significance of mathematics resides precisely in the fact that it is an art; by informing us of the nature of our own minds it informs us of much that depends on our minds. It does not enable us to explore some remote region of the eternally existent; it helps to show us how far what exists depends upon the way in which we exist. We are the lawgivers of the universe; it is even possible that we can experience nothing

sus Christ). Hence, it is natural and logical for a scientist believing in one God (but not in His only-begotten Son, Jesus Christ), whether personal or impersonal (as in the case of Einstein), to slip into pantheism when faced with explaining the order of the universe (called *monogenes* by the Greeks and which the Greeks attributed to an impersonal *logos*). Another prominent Jewish example of this "slip into pantheism" is Baruch Spinoza (1632-1677). As for the Muslims, it is enough to think of Averroës (1126-1198) and his followers.

[29]*Ibid.*, p. 4.

[30]Cited in Davis and Hersh, *The Mathematical Experience*, p. 172.

[31]Jaki, *The Relevance of Physics*, p. 101.

but what we have created and that the greatest of our mathematical creations is the material universe itself."[32]

Percy W. Bridgman (1882-1961), a 1946 Nobel Prize winner in physics, said, "It is the merest truism, evident at once to unsophisticated observation, that mathematics is a human invention."[33]

Sir Arthur Stanley Eddington (1882-1944), British astronomer, graphically explained the origin and originator of all things:

> We have found that where science has progressed the farthest, the mind has but regained from nature that which the mind has put into nature. We have found a strange foot-print on the shores of the unknown. We have devised profound theories, one after another, to account for its origin. At last, we have succeeded in reconstructing the creature that made the foot-print. And Lo! it is our own.[34]

Figure 103: Sir Arthur Stanley Eddington

Morris Kline gives affirmation:

> It may be that man has introduced limited and even artificial concepts and only in this way has managed to institute some order in nature. Man's mathematics may be no more than a workable scheme. Nature itself may be far more complex or have no inherent design.[35]

To the majority of mathematicians today, the universe does not reveal a preestablished harmony. Hence, to these men, mathematics, as a method, does not reveal a harmonious order established by the biblical God; it enables man to create order out of a multiverse of assumed chaos. The presuppositions of these men have blinded them to the realization that the basic function of mathematics is interpretive. Mathematics is a tool of quantification; it cannot create what is quantifies. Mathematics is a reporter of the external, objective, and pre-established world.

The difference in perspectives is clear. Man is either a discoverer or an autonomous creator. Since both viewpoints posit explanations concerning the

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[32]John W. N. Sullivan, "Mathematics as an Art," *The World of Mathematics*, ed. James R. Newman (New York: Simon and Schuster, 1956), 3:2021. Note the distinct Kantian impress in his remarks.
[33]Percy W. Bridgman, *The Logic of Modern Physics* (New York: Macmillan, 1927), p. 60.
[34]Arthur Stanley Eddington, *Space, Time and Gravitation: An Outline of the General Theory of Relativity* (Cambridge: Cambridge University Press, 1920), p. 201.
[35]Kline, *Mathematics: The Loss of Certainty*, p. 350. Even the complexity of the so-called "Chaos" theory reveals an underlying structure and order. James Gleick notes that many in this field of study have "discovered suggestions of structure amid seemingly random behavior." See *Chaos: Making a New Science* (New York: Penguin Books, 1987), p. 44.

origin, purpose, and destiny of the cosmos, then *both are integrally religious in nature*. As Rousas J. Rushdoony points out:

> ... mathematics is not the means of denying the idea of God's pre-established world in order to play god and create our own cosmos, but rather is a means whereby we can think God's thoughts after Him. It is a means towards furthering our knowledge of God's creation and towards establishing our dominion over it under God. The issue in mathematics today is root and branch a religious one."[36]

6.3 A QUANTUM LEAP

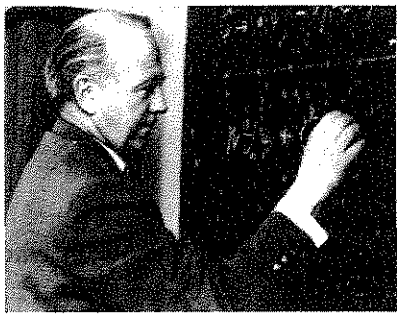

Figure 104: Werner Karl Heisenberg

To some, this talk about harmonious order and its underlying ontological commitment to causality (cause and effect relationships) is irrelevant given the "uncertainty principle" first conceptualized by Werner Karl Heisenberg (1901-1976) in 1927.[37] In the realm of quantum mechanics, this principle states that you cannot measure momentum and position of an atomic particle at the same time. That is, there is an inherent limitation to the accuracy that can be achieved in measurements and this limitation is *only* noticeable on the atomic level (physicists have to resort to statistical averages rather than exact measurement). From this, Heisenberg, using a Humean springboard, immediately jumped to the conclusion that causality thereby had definitively been disproved. In 1929, he argued that "the resolution of the paradoxes of atomic physics can be accomplished only by further renunciation of old and cherished ideas. Most important of these is the idea that natural phenomena obey exact laws – the principle of causality."[38]

It is important to note that Heisenberg *assumed* that causality in a physical process depended upon its exact measurability. This assumption cannot be faulted for it was the fruit of the philosophical barrenness that had been growing for centuries in the Western mind. During these centuries the scientific mind had come under subjugation to a purely mechanistic cosmology due to the quantitative successes of measurement in physics. Because of this absolutization of a quantitative and mechanistic picture of the world, Heisenberg made

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[36]Rushdoony, *The Philosophy of the Christian Curriculum*, p. 58.

[37]Werner Heisenberg, *The Physical Principles of the Quantum Theory*, trans. C. Eckart and F. C. Hoyt (Chicago: University of Chicago Press, 1930). This principle is also called the indeterminacy principle.

[38]*Ibid.* p. 62. Scientific indeterminacy is, in reality, much more than using statistical probabilities to understand the quantum matrix. The denial of causality embraces a metaphysic of a blind, impersonal, and purposeless force or energy.

the mistake that the *inability of the physicists to measure nature exactly* showed the *inability of nature to act exactly*. The seeming truth of the foregoing statement depended on taking the word "exactly" in two different meanings: one operational (quantifiable), the other ontological (metaphysical). The philosophical conclusion that Heisenberg drew from his uncertainty principle is a classic example of falling prey to the logical fallacy of equivocation, the fallacy of mixing up unequal and heterogeneous quantities.[39]

It may be that behind the physics of quantum mechanics lies a higher degree of unity and harmony that our current instrumentation cannot yet measure. The wisdom and logic of the quantum realm may be so complex that we may never be able to unravel it. The only instrumentality that we have to help us describe this realm now are the wonderful tools that mathematics gives us.

6.4 A DEEPER LOOK INTO MORRIS KLINE

Perhaps no one has been more prolific in writing about mathematics in the late 20th century than Morris Kline (1908-1992). Obviously well qualified, talented, and articulate, his erudite works on the history and scientific applications of mathematics have had beneficial influence worldwide.

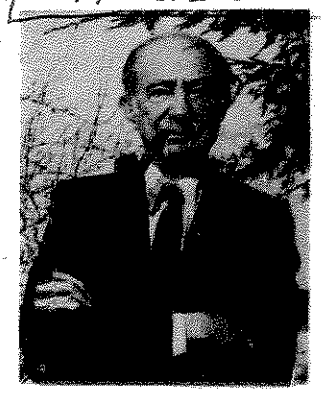

Figure 105: Morris Kline

But, at the same time, he was an apparent thorn in the flesh to the professional mathematical community. In 1973, he published a critical appraisal of the new mathematics curriculum of the 1960s entitled *Why Johnny Can't Add: The Failure of the New Mathematics*. After shooting down the methodology of pre-university mathematics, he next took aim at the university professors of mathematics. In 1977, his publication *Why the Professor Can't Teach: Mathematics and the Dilemma of University Education* certainly did not win him too many friends in the higher circles of the educational elite. Finally, in 1980, the publication of *Mathematics: The Loss of Certainty* unveiled a most thorough indictment of modern mathematics. We will leave it to the mathematics professionals to quibble over Dr. Kline's bombastic exposures. In the mean time, we will take note of some of Kline's revealing conclusions concerning mathematics.

In his introduction to *Mathematics: The Loss of Certainty*, he states, "It behooves us therefore to learn why, despite its uncertain foundations, and despite

[39]That Heisenberg and other physicists did not and do not recognize this fallacy reflects on the calamitous consequences resulting from the dearth of unity between departments of the modern university (or, more accurately, multiversity – see section 3.13); i.e., the logic department has nothing to say to the physics department. For more analysis, see the chapter entitled "Turtles and Tunnels" in Jaki, *God and the Cosmologists*, pp. 117-147.

unreasonable effectiveness of mathematics

the conflicting theories of mathematicians, mathematics has proved to be so incredibly effective."[40]

In his preface to *Mathematics and the Physical World*, he reflects:

> Finally, a study of mathematics and its contributions to the sciences exposes a deep question. Mathematics is man-made. The concepts, the broad ideas, the logical standards and methods of reasoning, and the ideals which have been steadfastly pursued for over two thousand years were fashioned by human beings. Yet with this product of his fallible mind man has surveyed spaces too vast for his imagination to encompass; he has predicted and shown how to control radio waves which none of our senses can perceive; and he has discovered particles too small to be seen with the most powerful microscope. Cold symbols and formulas completely at the disposition of man have enabled him to secure a portentous grip on the universe. Some explanation of this marvelous power is called for.[41]

Kline is not alone in this acute cry for an explanation. Richard Courant (1888-1972), formerly head of the mathematics department at the pre-Hitler world's center for mathematics, the University of Göttingen, and then head of the Courant Institute of Mathematical Sciences of New York University, remarks, "That mathematics, an emanation of the human mind, should serve so effectively for the description and understanding of the physical world is a challenging fact that has rightly attracted the concern of philosophers."[42]

Richard E. Von Mises (1883-1953), who was born in Austria and later became a lecturer at Harvard University, agrees with Courant by stating that "the coordination between mathematics ... and reality cannot be reached by a mathematicized doctrine...."[43] He goes on to remark:

> None of the three forms of the foundation of mathematics, the intuitionist, the formalist, or the logistic, is capable of completely rationalizing the relation between tautological systems and (extramathematical) experiences, which is its very purpose, i.e., to make this relation a part of the mathematical system itself.[44]

Norman Campbell, British physicist and philosopher of science, queries about the remarkable power of mathematics in prediction:

> Why do they predict? We return once again to the question which we cannot avoid. The final answer that I must give is that I do not know, that nobody knows, and that probably nobody ever will know.[45]

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[40]Kline, *Mathematics: The Loss of Certainty*, p. 8.
[41]Kline, *Mathematics and the Physical World*, p. ix.
[42]Richard Courant, "Mathematics in the Modern World," *Scientific American*, 211 (1964), 48-49.
[43]Von Mises, 3:1752-1753.
[44]*Ibid.*, 3:1754.
[45]Norman Campbell, *What is Science?* (New York: Dover Publications, 1952), p. 71.

Mathematics historian Salomon Bochner (1899-1982) confesses:

> What makes mathematics so effective when it enters science is a mystery of mysteries, and the present book wants to achieve no more than to explicate how deep this mystery is.[46]

All of these men begin with the explicit assumption that mathematics is merely and only a creation of the human mind. Given this premise, they are unable to completely explain the marvelous power of mathematics, the power of describing and predicting the workings of the physical world. In finality, they must consign themselves, as Bochner and Kline do, to the use of the expression, "It is a mystery."[47]

6.5 THE CONFESSIONS OF A NOBEL PRIZE WINNER

In 1963, Eugene Wigner (1902-1995) won the Nobel Prize in physics for his research in quantum mechanics. In 1960, he wrote an article with a revealing title: "The Unreasonable Effectiveness of Mathematics in the Natural Sciences." To begin his discussion, he quoted the philosopher Charles Sanders Peirce (1839-1914): "It is probable that there is some secret here which remains to be discovered."[48] Then he presented his thesis, "The enormous usefulness of mathematics in the natural sciences is something bordering on the mysterious and ... there is no rational explanation for it."[49] He explains these successes using an interesting metaphor:

Figure 106: Eugene Wigner

> We are in a position similar to that of a man who was provided with a bunch of keys and who, having to open several doors in succession, always hit on the right key on the first or second trial. He became skeptical concerning the uniqueness of the coordination of keys and doors.[50]

Wigner continues to express his bafflement over the fact that "it is not at all natural that 'laws of nature' exist, much less that man is able to discern them."[51] Concerning the effectiveness of Newton's law of universal gravitation, he says that it "has proved accurate beyond all reasonable expectations."[52]

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[46]Salomon Bochner, *The Role of Mathematics in the Rise of Science* (Princeton: Princeton University Press, 1966), p. v.
[47]Kline, *Mathematics: The Loss of Certainty*, p. 7.
[48]Cited in Eugene Wigner, *Symmetries and Reflections: Scientific Essays* (Cambridge and London: The MIT Press, 1970), p. 222.
[49]*Ibid.*, p. 223.
[50]*Ibid.*
[51]*Ibid.*, p. 227.
[52]*Ibid.*, p. 231.

He continues to illustrate the mysterious usefulness of mathematics by citing the application of imaginary numbers (e.g., $\sqrt{-1}$) in the laws of quantum mechanics. First, he observes that "the use of complex numbers is in this case not a calculational trick of applied mathematics but comes close to being a necessity in the formulation of the laws of quantum mechanics."[53] Given this fact, he responds with this amazing remark, "It is difficult to avoid the impression that a miracle confronts us here."[54]

6.5.1 THE STRUCTURE OF THE ATOM IN QUANTUM MECHANICS

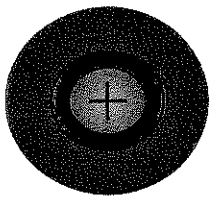

Figure 107: Quantum Atomic Structure

In the hydrogen atom, electrons are pictured as clouds that orbit the positive nucleus. The darker section of this time-average view shows where the electron is most probably found.

Finally, he concludes, "Fundamentally, we do not know why our theories work so well."[55] And to this, he concludes:

> The miracle of appropriateness of the language of mathematics for the formulation of the laws of physics is a wonderful gift which we neither understand nor deserve. We should be grateful for it and hope that it will extend, for better or for worse, to our pleasure even though perhaps also to our bafflement, to wide branches of learning.[56]

6.6 MORE MIRACLES, MYSTERY, AND WONDER

Erwin Schrödinger (1887-1961) developed the famous wave equation of quantum mechanics that includes the "miraculous" imaginary number mentioned by Wigner.[57] He affirms Wigner in observing that humanity's power to

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[53] *Ibid.*, p. 229.

[54] *Ibid.*

[55] *Ibid.*, p. 237.

[56] *Ibid.*

[57] The time dependent Schrödinger equation where $\psi(t)$ is a function giving both the space and time of the matter wave associated with a particle of mass m moving in a region where the potential energy is U(x) is:

$$\frac{\partial^2\psi(x,t)}{\partial x^2} = -\frac{8\pi^2 m}{h^2}\left[\frac{ih}{2\pi}\frac{\partial\psi(x,t)}{\partial t} - U(x)\psi(x,t)\right]$$ where h = Planck's constant and $i = \sqrt{-1}$.

discover the laws of nature is beyond human understanding.[58] The same miracle appears again as he reflects on the atomic structure of genes:

> How can we, from the point of view of statistical physics, reconcile the facts that the gene structure seems to involve only a comparatively small number of atoms (of the order of 1000 and possibly less), and that nevertheless it displays a most regular and lawful activity – with a durability or permanence that borders upon the miraculous.[59]

Figure 108: Erwin Schrödinger

In 1980, Richard W. Hamming (1915-1998), university professor, tried to explain the mystery proposed by Dr. Wigner. He introduced his treatise, "We must begin somewhere and sometime to explain the phenomenon that the world seems to be organized in a logical pattern that parallels much of mathematics."[60] After several pages of discourse, he came to this conclusion, "From all of this I am forced to conclude both that mathematics is unreasonably effective and that all of the explanations I have given when added together simply are not enough to explain what I set out to account for."[61]

Dr. Remo J. Ruffini, physicist at Princeton University, reacted to the successful landing of men on the moon:

> How a mathematical structure can correspond to nature is a mystery. One way out is just to say that the language in which nature speaks is the language of mathematics. This begs the question. Often we are both shocked and surprised by the correspondence between mathematics and nature, especially when the experiment confirms that our mathematical model describes nature perfectly.[62]

Albert Einstein once remarked concerning this issue, "The eternal mystery of the world is its comprehensibility."[63] One of his friends, Maurice Solovine, asked Einstein to clarify this remark. Einstein replied:

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[58]Erwin Schrödinger, *What is Life? The Physical Aspects of the Living Cell* (Cambridge: Cambridge University Press, 1945), p. 31.
[59]*Ibid.*, p. 46.
[60]Richard W. Hamming, "The Unreasonable Effectiveness of Mathematics," *American Mathematical Monthly*, 87 (1980), 81.
[61]*Ibid.*, 90.
[62]Remo J. Ruffini, "The Princeton Galaxy," interviews by Florence Heltizer, *Intellectual Digest*, 3 (1973), 27.
[63]Einstein, *Out of My Later Years*, p. 61.

> You find it surprising that I think of the comprehensibility of the world ... as a miracle or an eternal mystery. But surely, a priori, one should expect the world to be chaotic, not to be grasped by thought in any way. One might (indeed one *should*) expect that the world evidence itself as lawful only so far as we grasp it in an orderly fashion. This would be a sort of order like the alphabetical order of words of a language. On the other hand, the kind of order created, for example, by Newton's gravitational theory is of a very different character. Even if the axioms of the theory are posited by man, the success of such a procedure supposes in the objective world a high degree of order which we are in no way entitled to expect a priori. Therein lies the "miracle" which becomes more and more evident as our knowledge develops.... And here is the weak point of positivists [true knowledge is that which can *only* be verified by the senses or experience - J.N.] and of professional atheists, who feel happy because they think that they have not only pre-empted the world of the divine, but also of the miraculous. Curiously, we have to be resigned to recognizing the "miracle" without having any legitimate way of getting any further. I have to add the last point explicitly, lest you think that, weakened by age, I have fallen into the hands of priests.[64]

Figure 109: Albert Einstein

To Einstein, there is no "legitimate" way to get around recognizing the miracle. To him, to explain the miracle in terms of the "divine" would be "falling into the hands of priests" and therefore, in accordance with his convictions, sacrilegious. Stanley L. Jaki exposes the obvious by remarking that Einstein "perceived that such a train of thought was not only a road of science but it also came dangerously close to turning at the end into a way to God."[65] Dr. Ruffini is another scientist who openly admitted, after his testimony above, that the mystery of mathematical effectiveness can be solved by positing the biblical God. But, as Einstein, he considered this explanation to be unacceptable. According to Rousas J. Rushdoony, Ruffini "prefers to deny the theoretical possibility of a correlation and meaning than to admit the reality of the Creator God."[66]

Most scientists, however, run away from this problem and do what Morris Kline describes, "Indeed, faced with so many natural mysteries, the scientist is only too glad to bury them under a weight of mathematical symbols, bury them

How much has responded to the issue of effectiveness.

[64]Albert Einstein, *Lettres À Maurice Solovine* (Paris: Gauthier-Villars, 1956), pp. 114-115 and cited in Jaki, *The Road of Science and the Ways to God*, pp. 192-193.
[65]Jaki, *The Road of Science and the Ways to God*, p. 193.
[66]Rushdoony, *The Philosophy of the Christian Curriculum*, p. 102.

so thoroughly that many generations of workers fail to notice the concealment."[67]

6.7 THE REAL ISSUE

Why bury and conceal? Is the mathematician running away from an issue that he does not want to confront? Yes. Using the words of Herbert Schlossberg, "Scientific scabbards fall away to reveal ideological swords."[68] Morris Kline summarizes the attitude of most mathematicians today, "Many mathematicians are happy to accept the remarkable applicability of mathematics but confess that they are unable to explain it."[69]

Willem Kuyk, professor of mathematics at the University of Antwerp in Belgium, explains why mathematicians do not want to explain:

> The question whether it is possible to make some kind of ontology the basis of modern mathematics is left open by most people working in mathematical fields. Fearing to introduce into mathematics arguments of a metaphysical nature, the philosophically minded mathematician will avoid as much as possible reference to mathematical existence independent of human thought. In general it can be said that under the impact of the pragmatist attitude, for the philosopher of mathematics the workability of mathematical systems rather than their interpretability has become a central point of view. Reflections of an epistemological nature as well as reflections regarding for example mathematical truth are not readily undertaken by mathematicians of the pragmatistic type.[70]

Most mathematicians today would rather hide in the dark closet of pragmatism than come out into the bright light of biblical revelation.

6.8 THE WONDERS OF CREATION

The structure of the honeycomb is a series of interlocking regular hexagonal prisms. Through differential calculus, one can determine that this design is the most efficient possible. It wastes no space at all and is the most effective structure for strength against collapsing.

Creation is revelatory of God's attributes. According to Kepler, when one contemplates God's created order, he "immediately takes hold of God."[71] What is made reflects something about the maker. In the case of the honeycomb, we see the wisdom of the infinite Creator.

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[67]Morris Kline, *Mathematics and the Search for Knowledge* (New York: Oxford University Press, 1985), p. 146.
[68]Schlossberg, p. 145.
[69]Kline, *Mathematics and the Search for Knowledge*, p. 224.
[70]Willem Kuyk, "The Irreducibility of the Number Concept," *Philosophia Reformata*, 31 (1966), 37.
[71]Caspar, p. 374.

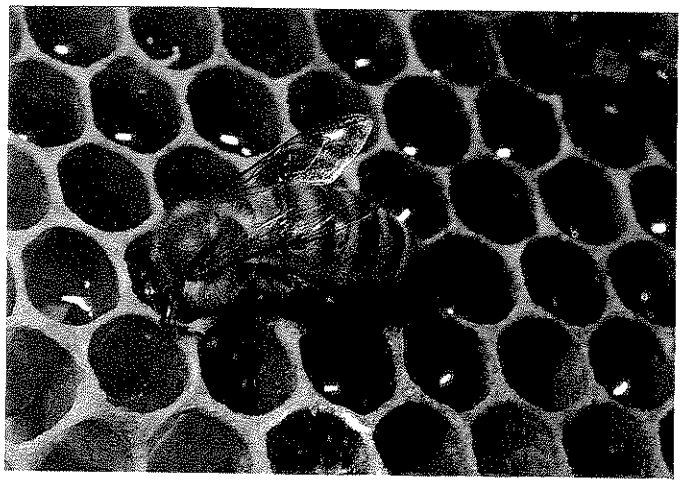

Figure 110: Honeycomb

optional

6.8.1 THE MATHEMATICS OF THE HONEYCOMB

The honeybee constructs the honeycomb by tessellating a series of regular hexagonal prisms with one end open and the other end a pointed trihedral apex (see Figure 111). The bee fabricates the displacement, x (see Figure 112), *so that the waxed surface area is minimal* (the bee also does less work for the same space when compared to the construction of square or triangular tessellations). Using the differential calculus, we can prove that God has designed the bee to construct a comb using the *minimal* surface area (i.e., the least amount of wax).

Let A = surface area,
a = length of each side of the hexagon,
h = height of the hexagonal prism, and
x = displacement.

If x = 0, then the base is flat. But, A (surface area) is *not* minimal. We can find the minimal surface area by taking the first derivative of x given the formula for the surface area. Then, we will set this derivative equal to zero and solve for x. Setting a = 1, the value of x thus calculated will give us the minimal surface area.

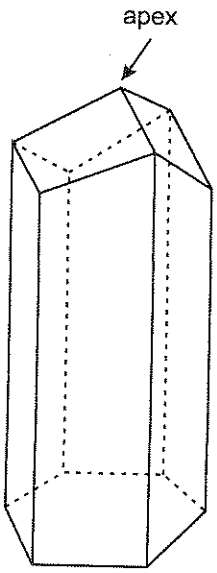

Figure 111: Trihedral apex of honeycomb cell

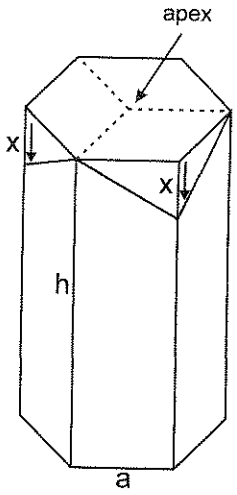

Figure 112: Regular hexagonal prism

$$A = 6(ah - \frac{ax}{2}) + 3a\sqrt{3}\sqrt{x^2 + \frac{a^2}{4}}$$

Take the derivative of A with respect to x; i.e. $\frac{d}{dx}A$

$$\frac{d}{dx}A = \frac{d}{dx}6ah - 3a\frac{d}{dx}x + 3a\sqrt{3}\frac{d}{dx}\left(x^2 + \frac{a^2}{4}\right)^{\frac{1}{2}}$$

$$\frac{d}{dx}A = 0 - 3a + 3a\sqrt{3}\left[\frac{1}{2}\left(x^2 + \frac{a^2}{4}\right)^{-\frac{1}{2}}2x\right]$$

$$\frac{d}{dx}A = -3a + 3a\sqrt{3}x\left(x^2 + \frac{a^2}{4}\right)^{-\frac{1}{2}}$$

Now, set $\frac{d}{dx}A = 0$ *and solve for* x:

$$-3a + 3a\sqrt{3}x\left(x^2 + \frac{a^2}{4}\right)^{-\frac{1}{2}} = 0$$

$$3a\sqrt{3}x\left(x^2 + \frac{a^2}{4}\right)^{-\frac{1}{2}} = 3a$$

$$x\left(x^2 + \frac{a^2}{4}\right)^{-\frac{1}{2}} = \frac{1}{\sqrt{3}} \Rightarrow \frac{\sqrt{x^2 + \frac{a^2}{4}}}{x} = \sqrt{3} \Rightarrow \frac{x^2 + \frac{a^2}{4}}{x^2} = 3 \Rightarrow 1 + \frac{a^2}{4x^2} = 3 \Rightarrow$$

$$\frac{a^2}{4x^2} = 2 \Rightarrow \frac{4x^2}{a^2} = \frac{1}{2} \Rightarrow 4x^2 = \frac{a^2}{2} \Rightarrow x^2 = \frac{a^2}{8}.$$

Hence, $x = \sqrt{\frac{a^2}{8}} = \frac{a}{\sqrt{8}} = \frac{a}{2\sqrt{2}} = \frac{a\sqrt{2}}{4}$.

If $a = 1$, *then* $x = .35355339$

The graph in Figure 113 plots the independent variable x (displacement) versus the dependent variable A (surface area) showing the minimal surface area at x ≈ .35

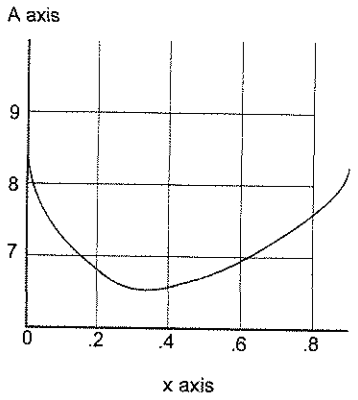

Figure 113: Minimal surface area plot of honeycomb cell

6.8.2 THE PATH OF LIGHT THROUGH A WATER DROPLET

The path of light can be determined by the laws of geometric optics. Each time that the beam strikes the surface of an individual droplet, part of the light is reflected and part is refracted. The following laws govern the degree of reflection/refraction (see Figure 114):

Let I = the angle of incidence,
R = the angle of reflection,
r = the angle of refraction,
V_1 = the velocity of light in the incident medium (air in this example), and
V_2 = the velocity of light in the refraction medium (water in this example).
According to the law of reflection, I = R.
According to the law of refraction, $\frac{\sin I}{\sin r} = \frac{V_1}{V_2}$.

Rays that are directly reflected from the surface are designated as TYPE 1 rays. Those rays transmitted directly through the droplet are classified as TYPE 2. TYPE 3 rays emerge from the droplet after one internal reflection. These rays produce the primary rainbow. A much fainter bow, called the secondary rainbow, is sometimes seen behind the primary rainbow. This bow is made up of TYPE 4 rays, which have undergone two internal reflections.

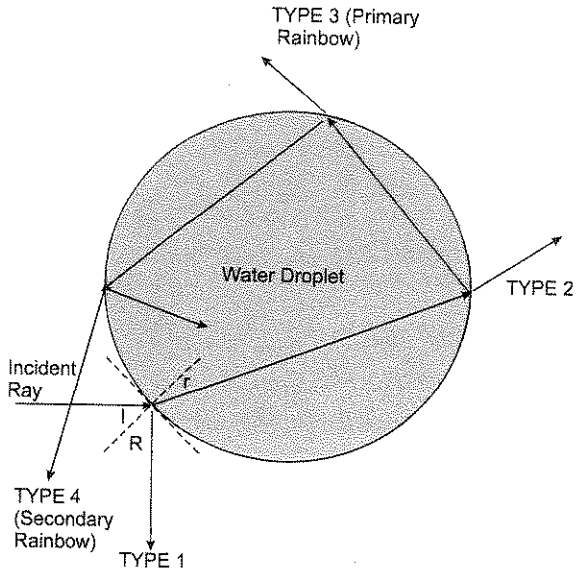

Figure 114: Path of light through a water droplet

In Scripture, the rainbow is a sign of God's covenant mercies (Genesis 9:8-17). The structure of a rainbow is complex and intricate. Detailing it could fill a large book. Carl Boyer extols the rainbow's properties:

> The rainbow is just about the most subtle phenomenon that everyday nature presents us; the creation of the familiar sun and rain, it is nevertheless as unapproachable as a spirit.[72]

H. E. Huntley reflects:

> The light of day is reflected, chromatically refracted, reflected again and dispersed by gently falling water spheres into a thousand hues, conforming the while to lovely theorems of mathematics so simple in some respects that the schoolboy may understand, so complex in others as to defy analysis.[73]

According to Larry Zimmerman, Christian educator, "the knowledge of mathematics unveils not only vistas of beauty and power unsuspected before

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[72]Carl Boyer, *The Rainbow: From Myth to Mathematics* (New York: Thomas Yoseloff, 1959), p. 20.
[73]H. E. Huntley, *The Divine Proportion: A Study in Mathematical Beauty* (New York: Dover Publications, 1970), p. 11. Huntley is citing from another book written by him, H. E. Huntley, *The Faith of a Physicist* (Bles, 1960), p. 12. For more detail on the mathematics of the rainbow, see H. Moyses Nussenzveig, "The Theory of the Rainbow," *Scientific American*, 236 (1977), 116-127.

but also an order, symmetry and infinitude which stuns and awes the beholder."[74]

We have seen that not only is mathematics useful in helping man to fulfill the dominion mandate of Scripture (Genesis 1:26-28), it also uniquely reveals certain attributes of the Creator God (for further detailed discussion, see sections 7.5 and 7.6). After God finished creating the heavens and the earth, He pronounced everything as "good." Although made by the word of His power and designed by His infinite wisdom, the works of God ultimately reflect the goodness of God (Genesis 1:31). The heart of goodness is generosity. In its essence, goodness is the desire to *do* good, to create a medium through which one can communicate freely and extravagantly. Being infinite, the biblical God communicates Himself to the degree of infinity! The voice of the good God is everywhere, waiting to be heard by those who have ears to hear.

The whole of creation is for man's services, food, and enjoyment. There is nothing in creation that does not contribute something either (1) to our welfare in the provision of our means, our health, our clothing, our service, or (2) to our sheer and unmitigated delight.

Mathematics serves as a unique method of describing the arrangement of God's good creation. In this arrangement, we see God's great and gracious concern to bless man. Over and above the mathematical formulae describing matter, motion, and forces, there is a message conveyed through the loving touch of personality. Through the manifold works of God, from the variegated rainbow to the delicate rose, the language of God's goodness reaches our hearts.

6.9 GUILTILY BLIND

We must expect that humanistic mathematicians will miss the whole point of the place of mathematics in the purposes of God. Not willing to submit their lives to their Maker, they are guiltily blind to the glory of God reflected in the unique mirror of mathematics. Because of this willful denial and suppression of evident truth, the mathematical structure of creation will be misunderstood and ultimately perverted.

Yet, if their practical day to day work is to be effective, scientists and applied mathematicians must make biblical assumptions about the physical world that are contrary to their voiced humanistic presuppositions. In the words of Albert Einstein, "Don't listen to their words, fix your attention on their deeds."[75] He continues:

> Without the belief that it is possible to grasp the reality with our theoretical constructions, without the belief in the inner harmony of our world, there could be no science.[76]

[74]Zimmerman, 2:3, 2.
[75]Einstein, *Essays in Science*, p. 12.
[76]Albert Einstein and Leopold Infeld, *The Evolution of Physics: The Growth of Ideas from the Early Concepts to Relativity and Quanta* (Cambridge: Cambridge University Press, 1938), p. 312.

Mathematicians and scientists today are living on borrowed capital; they are earning interest off a deposit that they no longer acknowledge or recognize to be genuine. As Stanley L. Jaki states, "Science is now in possession of such a vast interconnection of data, laws, and instruments as to continue its progress even if no attention is paid any longer to that faith which played an indispensable role in its rise."[77]

In essence, unbelieving scientists can do science *only because they operate secretly on Christian premises while denying that faith.* What they do in their scientific work expresses a biblical faith that contradicts their profession of unbelief. We must always remember that it is a gift of God's common grace that enables the unbelieving scientist of this age (or any age) to formulate and discover valid mathematical laws. It is Christ that "gives light to every man" (John 1:9) and it is God in Christ that "teaches man knowledge" (Job 32:8-9). According to Rousas J. Rushdoony:

> The unbeliever is thus able to think and work only on the basis of a practical reason which presupposes the Christian frame of things.... On his own premises, he can know nothing; on borrowed premises, he is able to think and work, but for all his results, he remains in the paradoxical position of the cattle rustler.... He has no knowledge on the basis of his own principles, he has valid knowledge only as a thief possesses stolen goods.[78]

Cornelius Van Til is direct and to the point:

> Sinners use the principle of Chance back of all things and the idea of exhaustive rationalization as the legitimate aim of science. If the universe were actually what these men assume it to be according to their principle, there would be no science. Science is possible and actual only because the non-believer's principle is not true and the believer's principle is true. Only because God has created the universe and does control it by His providence, is there such a thing as science at all.[79]

The rationalist John W. N. Sullivan echoed Van Til's remark by querying, "Why the external should obey the laws of logic; why, in fact, science should be possible, is not at all an easy question to answer."[80] Reflecting on this link between the laws of logic and the external world, the French physicist Louis-Victor de Broglie (1892-1987) remarked that the progress of science "has revealed to us a certain agreement between our thought and things, a certain possibility of grasping, with the assistance of the resources of our intelligence and the rules of reason, the profound relations existing between phenomena. We

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[77]Jaki, *Cosmos and Creator*, p. 139.
[78]Rushdoony, *By What Standard?*, pp. 61-62.
[79]Cornelius Van Til, *A Christian Theory of Knowledge* (Philadelphia: Presbyterian and Reformed, 1953), p. 193 and cited in Rushdoony, *The One and the Many: Studies in the Philosophy of Order and Ultimacy*, p. 15.
[80]Sullivan, 3:2020.

are not sufficiently astonished by the fact that any science may be possible."[81] Scientists must accept objective coherence in a *uni*verse of God's making, not a *multi*verse of man's construction, if there is to be any such thing as real science. If not, using the words of Stanley L. Jaki, "any analysis of knowledge becomes a celebration of incoherence."[82]

6.10 MATHEMATICS: METAPHYSICAL AND EPISTEMOLOGICAL REALITY

According to Max Caspar, Kepler's view of the world and his doctrine of knowledge were as follows:

> What supported and gave wings to Kepler in the execution of his program was a refreshing optimism about cognition. "Man, stretch thy reason hither, so that thou mayest comprehend these things"; that was the call which rang out for him from the material world. While he accepted this call with open ear, with the complete and unreserved readiness of a young mind, he believed in the reality of the things outside us and in the possibility of being able to comprehend them in their essence, order and meaning. What the eye brought him was that which he saw, and was in reality as he saw it; and the mind repeated the thoughts which God had materialized in His Creation. He did not start with doubt, as another soon did [Descartes – J.N.], but with an unquestioned faith in *ratio*. He did not limit himself to the framework of immanent thought, but became intoxicated with the contemplation of a transcendental truth. He had not yet fallen into the abyss of relativity, but was deeply convinced that there is an absolute truth. Admittedly our mind never can completely grasp this truth, but it is the noble task of scientific and philosophical research to draw nearer to it.[83]

James Clerk Maxwell (1831-1879) developed mathematical equations that enabled scientists to accomplish wonders with electrical and magnetic phenomena.[84] Not only are these equations profound, comprehensive, and effective, they are also extremely beautiful and symmetric. According to Norman Campbell, these equations illustrate "the marvellous power of pure thought, aiming only at the satisfaction of intellectual desires (e.g., beauty, order, symmetry), to con-

Figure 115: James Clerk Maxwell

[81]Louis-Victor de Broglie, *Physics and Microphysics*, trans. M. Davidson (New York: Pantheon Books, 1955), pp. 208-209.
[82]Jaki, *Cosmos and Creator*, p. 97.
[83]Caspar, p. 377.
[84]For a description of Maxwell's method, see Kline, *Mathematics and the Search for Knowledge*, pp. 126-147, 166-167 and Kline, *Mathematics in Western Culture*, pp. 304-321.

trol the external world."[85] According to Stanley L. Jaki, Maxwell's electromagnetic equations are "possibly the most beautiful equations until then formulated in theoretical physics."[86]

When Heinrich Hertz (1857-1894) discovered the existence of radio waves in space, he verified all of Maxwell's equations and ensuing predictions. The response of Hertz is informative:

> One cannot escape the feeling that these mathematical formulas have an independent existence and an intelligence of their own, that they are wiser than we are, wiser even than their discoverers, that we get more out of them than was originally put into them."[87]

Philip E. B. Jourdain (1879-1914), mathematician and son of a Derbyshire vicar, observed that:

> ... the nature of Mathematics is independent of us personally and of the world outside, and we can feel that our own discoveries and views do not affect the Truth itself, but only the extent to which we or others see it .... Some philosophers have reached the startling conclusion that Truth is made by men, and that Mathematics is created by mathematicians, and that Columbus created America....[88]

Figure 116: Godfrey H. Hardy

Godfrey H. Hardy (1877-1947) considered God to be his personal enemy and prided himself in the claim that none of his mathematics would ever apply to any aspect of the real world. He finally had to confess that "mathematical reality lies outside of us. Our function is to discover, or observe it, and that the theorems which we describe grandiloquently as our creations are simply notes on our observations."[89] After Hardy's death, his mathematical results were applied to the physical world.[90]

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[85]Campbell, p. 156. For Maxwell, the motivation for his scientific studies stemmed from his belief in the Genesis account of the creation of man in God's image and the command to man to subdue the earth. See Lewis Campbell and William Garnet, *The Life and Times of James Clerk Maxwell* (London: Macmillan and Company, 1882), p. 323 (http://www.sonnetusa.com/bio/maxbio.pdf, p. 160).

[86]Jaki, *Cosmos and Creator*, pp. 31-32.

[87]Cited in Bell, *Men of Mathematics*, p. 16.

[88]Philip E. B. Jourdain, "The Nature of Mathematics," *The World of Mathematics*, ed. James R. Newman (New York: Simon and Schuster, 1956), 1:71.

[89]Godfrey H. Hardy, *A Mathematician's Apology* (Cambridge: Cambridge University Press, 1967), pp. 123-124.

[90]How were Hardy's results applied? One of his conclusions has been applied to genetics and it has turned out to be known as Hardy's law, a law "of central importance in the study of Rh-blood groups and the treatment of haemolytic disease of the newborn." E. C. Titchmarsh, "Obituary of G. H. Hardy," *The Journal of the London Mathematical Society* (April 1950), p. 83. His work in number

Albert Einstein confessed in 1934, "To him who is a discoverer in this field the products of his imagination appear so necessary and natural that he regards them, and would like to have them regarded by others, not as creations of thought but as given realities."[91]

Nicholas Bourbaki, a collective pseudonym for a group of French mathematicians, said in 1950:

> That there is an intimate connection between experimental phenomena and mathematical structures, seems to be fully confirmed in the most unexpected manner by the recent discoveries of contemporary physics ... but we are completely ignorant as to the underlying reasons for this fact ... and we shall perhaps always remain ignorant of them.[92]

Bourbaki concludes:

> Mathematics appears thus as a storehouse of abstract forms ... and it so happens – without our knowing why – that certain aspects of empirical reality fit themselves into these forms, as if through a kind of preadaptation.[93]

6.11 THE UNIFYING FACTOR

Sir Oliver Graham Sutton remarks, "How can the manipulation of symbols which *we* have invented, according to rules which *we* alone make (and sometimes break), reveal that which lies beyond our senses?"[94] To him, this question "is one which is unlikely to receive a satisfactory answer...."[95] Then, he makes a remarkable and accurate observation:

> The universe, both as a whole and in its microstructure, suggests that in neither aspect can it be treated merely as an enlarged or diminished version of the world which we know through our senses. The ultimate secrets of nature are written in a language which we cannot yet read. Mathematics provides a commentary on the text, sometimes a close translation, but in words we can read because they are our own.[96]

Why does mathematics work? Why does it fit the real world? What is the reason for this mysterious coherence between mathematical thought and empirical reality? What is the ultimate metaphysical "language of the universe" that mathematics gives dim commentary to? If mathematics is just a product of

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theory has been used extensively in the investigation of the temperature of furnaces. See John B. S. Haldene, *Everything Has a History* (London, 1951), p. 240.

[91]Einstein, *Essays in Science*, p. 12.

[92]Nicholas Bourbaki, "The Architecture of Mathematics," *American Mathematical Monthly*, 57 (1950), 231.

[93]*Ibid.*

[94]Sutton, p. 3.

[95]*Ibid.*, p. 4.

[96]*Ibid.*, p. 23.

man's autonomous reason, then the answers to these questions will forever remain a mystery.

Early in the 20th century, Philip E. B. Jourdain remarked that mathematics "really occupies a place sometimes reserved for an even more sacred Being."[97] According to Max Caspar's understanding of Kepler's epistemology, "The fact that the world and man's mind are images of God in their manner, makes knowledge possible, a knowledge which not only is certain but also carries sense and value in itself."[98]

Henry Morris (1918-), a pioneer in the field of creation science, observes:

> The more intensively and thoroughly man probes the universe – whether the submicroscopic universe of the atomic nucleus or the tremendous metagalactic universe of astronomy – the more amazingly intricate and grand are God's reservoirs of power revealed to be.[99]

For Larry Zimmerman, mathematics is more than just the free creation of the human mind. He says:

> It is possible, that mathematics is an entity which always exists in the mind of God, and which is for us the universal expression of His creative and sustaining word of power.... So we would expect the deepest scientific probes into the micro- or macro-cosmos to reveal a language fabric in which are woven the forces and relationships governing the tangible creation. This language fabric should itself be suggestive of an intellectual antecedent, an orderly, powerful, infinitude of thought, a "terra incognita of pure reasoning" which "casts a chill on human glory."[100]

Vern S. Poythress agrees with Zimmerman and reflects upon the linguistic character of God's creation:

> The created world, *as* result of God's speech, bears within it from top to bottom a kind of quasilinguistic character ... through God's act of creation, things in the world themselves become wordless voices to the praise of God.[101]

Edward Everett (1794-1865), president of Harvard, was the first American to earn a doctor's degree at the University of Göttingen. In the autumn of 1863 at Gettysburg, Pennsylvania, he took the stage and spoke for two hours as part of a tribute ceremony for those who fought and for those who died in the Battle of Gettysburg (July 1-3, 1863). What he said no one remembers or cares to remember. It was what the succeeding speaker said in a short, two to three mi-

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[97]Jourdain, 1:71.
[98]Caspar, p. 381.
[99]Henry Morris, *The Biblical Basis for Modern Science* (Grand Rapids: Baker, 1984), p. 52.
[100]Zimmerman, 2:2, 1.
[101]Poythress, p. 5.

nute address that everyone remembers. That speaker was Abraham Lincoln. Note Everett's remarkable observation about the nature of mathematical truth:

> The great truths with which it [mathematics – J.N.] deals, are clothed with austere grandeur, far above all purposes of immediate convenience or profit. It is in them that our limited understandings approach nearest to the conception of that absolute and infinite.... In the pure mathematics we contemplate truths, which existed in the divine mind before the morning stars sang together, and which will continue to exist there, when the last of the radiant host shall have fallen from heaven. They existed not merely in metaphysical possibility, but in the actual contemplation of supreme reason. The pen of inspiration, ranging all nature and life for imagery, to set forth the Creator's power and wisdom, finds them best symbolized in the skill of the surveyor.[102]

Figure 117: Edward Everett

Whether pure mathematics can be *equated* with the divine mind is open to serious debate. Can we say with assurance, in the words of James Jeans, that God, the Great Architect of the universe, is a pure mathematician? In other words, can we *equate* the pure mathematics of today with the very mind of God? This statement is an example of univocal reasoning (see section 2.5) and according to Isaiah 55:8-9, this type of reasoning is impossible. To equate pure mathematics with the mind of God is to lift the finite into the infinite. It is the infinite that penetrates the finite, not vice versa. It is God who teaches man, not man who teaches God (Job 32:8-9; Job 38:2; Job 38:36; Psalm 94:10; Isaiah 40:13-14). Whatever man knows rightly, it is a gift of God in Christ (John 1:9). This gift of grace sometimes enthralls man, sometimes humbles man, and, sometimes confuses man in his disobedience (we see all three of these aspects in the mathematical realm). Man's mathematical knowledge will never exhaust the infinite panorama of God's knowledge (I Samuel 2:3; Psalm 147:5). At best, man is gifted with an infinitesimal subset of God's exhaustive wisdom and knowledge (Psalm 104:24). At best and in accordance with Kepler's convictions, the propositions of mathematics dimly reflect that ultimate reality of God's sustaining word of power. Every atom of the universe reflects His order and conforms to His decree. The mind of man, created in His image, can grasp a semblance of this order through the propositions of mathematics. This understanding can never be exhaustive (it can never encompass comprehensive intelligibility), but it can approximate truth. As Stanley L. Jaki remarks, "Only the kernel of scientific truth will become better defined as time goes on."[103]

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[102]Edward Everett, *Orations and Speeches* (Boston, 1870), 3:514.
[103]Jaki, *The Relevance of Physics*, p. 137.

As a Fellow of the Royal Society and Regius professor of mathematics at the University of St. Andrews in Scotland, Herbert Westren Turnbull (1885-1961) was well known for his research in algebra (determinants, matrices, and theory of equations). At the conclusion of his biographical history of mathematics, his thoughtful summarization reflects a unique balance of simplicity and elegance:

Figure 118: Herbert Westren Turnbull

> The story has now been told of a few among many whose admirable genius has composed the lofty themes which go to form our present-day heritage … if this little book perhaps may bring to some, whose acquaintance with mathematics is full of toil and drudgery, a knowledge of those great spirits who have found in it an inspiration and delight, the story has not been told in vain. There is a largeness about mathematics that transcends race and time: mathematics may humbly help in the market-place, but it also reaches to the stars. To one, mathematics is a game (but what a game!) and to another it is the handmaiden of theology. The greatest mathematics has the simplicity and inevitableness of supreme poetry and music, standing on the borderland of all that is wonderful in Science, and all that is beautiful in Art. Mathematics transfigures the fortuitous concourse of atoms into the tracery of the finger of God.[104]

Figure 119: Paul A. M. Dirac

What is made reflects the maker. Creation is a showcase of God's splendor, cunning, and power; i.e., creation is the tracery of the finger of God. Man, made in the analogical image of God, has been, for millennia, using his powers of ingenuity, in the words of Paul A. M. Dirac (1902-1984) – 1933 Nobel Prize winner in atomic theory – in "developing fundamental physical laws … in terms of a mathematical theory of great beauty and power."[105] In probing the creation, man has discovered and formulated relationships that reflect the language fabric of the "word of God's power" and in so doing has exposed the ingenuity of the Creator.

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[104]Herbert Westren Turnbull, *The Great Mathematicians* (New York: Barnes & Noble, [1929] 1993), p. 141.

[105]Paul A. M. Dirac, "The Evolution of the Physicist's Picture of Nature," *Scientific American*, 208 (1963), 53.

According to Stanley L. Jaki, the universe "has supreme coherence from the very small to the very large.... It is beautifully proportioned into layers of dimensions and yet all of them are in perfect interaction."[106] God, the author of this wonderful, marvelous, and coherent display, has gifted the mind of man with the capabilities of grasping it.

Charles Hermite (1822-1901), a mathematical analyst who proved the transcendence of *e* in 1873, offered this explanation for the agreement between mathematics and the physical world:

> There exists, if I am not deceived, a world which is the collection of mathematical truths, to which we have access only through our intellects, just as there is the world of physical reality; the one and the other independent of us, both of divine creation, which appear distinct because of the weakness of our minds, but for a more powerful mode of thinking are one and the same thing. The synthesis of the two is revealed partially in the marvelous correspondence between abstract mathematics on the one hand and all the branches of physics on the other.[107]

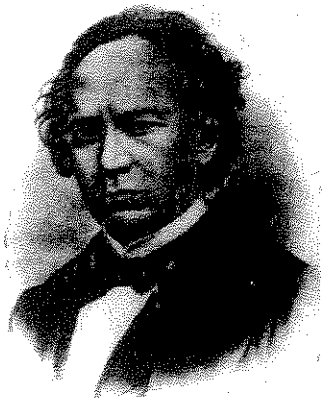

Figure 120: Charles Hermite

In *For the Beauty of the Earth,* a hymn of grateful praise written by Folliott S. Pierpoint in 1864, the poet thanked God for several marvelous truths: the beauty of the earth, the wonder of the day and night, the joy of human love, the church. In stanza five, using classical Keplerian ethos, he gave thanks to God for Hermite's "marvelous correspondence" with enchanting prose, "For the joy of ear and eye, for the heart and mind's delight, for the mystic harmony linking sense to sound and sight."

The Author of that mystic harmony linking sense to sound and sight is the biblical God. The mind of man, with its mathematical capabilities, and the physical world, with its observable mathematical order, *cohere* because of a common Creator. Einstein's eternal mystery has a solution. The biblical revelation of the Creator God is the unifying factor that reconciles what is irreconcilable in the humanistic context.

Men who follow in the train of Sullivan, Bridgman, Eddington, and Kline will never know the delight of this divinely orchestrated accord. Every time man boasts that the "footprint is his own," he is denigrating the gift of Christ (John 1:9). Men who claim the self-autonomy which seeks the measure of all things in man, men who pursue, with Promethean stubbornness, a reliance on

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[106]Jaki, *Cosmos and Creator*, p. 42.
[107]Cited in Kline, *Mathematics: The Loss of Certainty*, p. 345.

their own reasoning and their own abilities, in the end only fracture themselves, their science, and their mathematics with their impotent strikes at the Almighty. Instead of a science reflective of the aesthetic-metaphysical beauty of the Creator God, we now have a science of brute factuality. To the ethos of the noble Kepler we must return. We need scientists and mathematicians who boldly confess, "How great is the Creator who has made both the mind and nature so compatible!" We need scientists and mathematicians who see the universe, not as a mere mass of mechanistic and impersonal laws, but as the handiwork of God, and delight themselves therein. May God in His mercy add to this tribe and may the reader of this book be one of them.

QUESTIONS FOR REVIEW, FURTHER RESEARCH, AND DISCUSSION

1. Explain why the notion of "neutrality" in mathematics is mythological.
2. Explain the implications of a humanistic worldview in relationship to the current status and the future of mathematics and science.
3. Explain the only two assumptions that one can make about mathematics and its relationship to the physical world.
4. Carefully explain the following statement, "Only Christian monotheism can prevent one from venturing into the forest of pantheism."
5. Explain the statement, "The issue in mathematics today is root and branch a religious one."
6. Explain the dilemma that humanistic mathematicians face when they assume that mathematics is merely and only an invention of the human mind.
7. Explain how Heisenberg's denial of causality based upon his theory of quantum mechanics is an example of the logical fallacy of equivocation.
8. Comment on Einstein's reasons for claiming that the discourse of God does *not* belong to "natural philosophy."
9. Explain the schizophrenic attitude that humanistic mathematicians and scientists must have in order for their practical day to day work to be effective.
10. Explain why a biblical worldview necessitates a *uni*verse and why a humanistic worldview necessitates a *multi*verse.
11. Mathematics, as a language, serves as a faint "echo" of what metaphysical reality?
12. Carefully explain the following statement, "To equate the abstract logic of pure mathematics with the very mind of God is an example of autonomous univocal reasoning."
13. Carefully explain the following statement, "The validity of man's mathematical knowledge does not rest on it being exhaustively equal to the mind of God, but on it being reinterpretively analogous with the revelation of God."
14. Explain the biblical answer to the question, "Why does mathematics work?"