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LOGIC, QUANTUM PHYSICS, RELATIVISM, AND INFINITY: A RATIONAL APPROACH TO THEISM

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TOUGH-MINDED CHRISTIANITY

Honoring the Legacy *of* **JOHN WARWICK MONTGOMERY**

ISBN: 978-1-4336-6804-3

Published by B&H Publishing Group
Nashville, Tennessee

Dewey Decimal Classification: 239
Subject Heading: APOLOGETICS\
MONTGOMERY, JOHN W.\THEOLOGY

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Logic, Quantum Physics, Relativism, and Infinity

A Rational Approach to Theism

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Come now, let us reason together. (Isa 1:18)

In the beginning was Logic [the logos].
And Logic was with God, and Logic was God.

(John 1:1, most accurately translated by Gordon H. Clark)

In the nineteenth century Nietzsche declared "God is dead." He was inspired by the then new scientific revelations, especially by Charles Darwin's theories. But now, at the beginning of the twenty-first century, naturalistic explanations of our existence seem to be more and more implausible. In this article I describe a rational approach for our existence without any theistic or atheistic bias. This approach is based on new results of contemporary physics and the application of logic and plausibility. Quantum physics—once titled "Christianity's greatest challenge"—gives new insights on reality that may actually help theism.

I. Where Theists and Atheists May Agree

To be independent of theistic or atheistic bias, I will try to point out some premises that should be able to be agreed on by both sides:

1. Logic is an accurate tool to describe our reality (though not necessarily the only one).
2. Mathematically probable explanations are preferred in contrast to improbable ones for physical observations (at least if you don't know otherwise).

3. "*Pluralitas non est ponenda sine neccesitate*" (Occam's Razor), i.e., "Plurality should not be posited without necessity." In other words, when competing theories attempt to explain something, use the "simplest" explanation that has the least assumptions.
4. The law of causality ("Every effect has a cause") is an apodictic property of our physical reality.
5. The contemporary knowledge of science should be included in our philosophical considerations (but not dogmatically).

Let me comment briefly on this. The first premise is (hopefully) agreed on by everyone; otherwise meaningful communication is not possible. Of course, we experience more than logic in our life, e.g., music, art, or feelings. And they may very well be used to describe parts of our reality. But the most unambiguous way to communicate is via logic. Most sentences in this and the other articles in this book are compounded by logical statements, which at least its authors believe to be true. I once heard someone say, "If logic is not true, then. . . ." I interrupted this person at this point and said that without logic there is no "if . . . then" because this is a law of logic itself. Hence one can't use an "if . . . then" construct if not presuming the validity of logic.

The second premise is sometimes refuted by statements such as the following: "This very situation in this very moment is extremely improbable, since trillions of other possibilities could have been actualized; nevertheless it is happening right now." Such statements expose a deep misunderstanding of how statistic works. What you need beforehand are categories. Take, e.g., a lottery. To determine the mathematical probability of a certain combination of numbers, let's say six out of 49, you find approximately 14 million possibilities of combinations. Every combination is equally (im-)probable: one out of 14 million. But is your lottery ticket worth something only because your personal combination is so special that it may not occur again in the other 14 million (minus one) cases? Of course not. Another thing has to take place: Your combination must be in the winning category! The drawing of lots separates the winners (first category) from the losers (second category). And the probability of

being in the first category is what counts because the second category is a kind of "black box" containing all the losers. Therefore the probability that your special number is in the category of the losers is very high. Probability is always connected with categories. And this is also how our common life-decisions work. You would not decide to walk across the street when the traffic light is red because you (at least unconsciously) know that by doing this the mathematical probability to fit the "category of dead people" is very high. You would not consider the walking across the street when the light is red as equivalent to the green light just because both events are surely unique in the universe and therefore equally "improbable."

Then there are people who say that even if an event is most improbable, it nevertheless can happen. It can even occur in the next second, since mathematical improbability doesn't say anything about when it happens. Look at the lottery above: Even if the chances to win are one out of 14 million (approx. $1{:}10^7$), almost every week people do win. So the improbable does happen! But in terms of science, this is not really a very improbable event. First of all, there are usually more than 14 million people who participate in the lottery; therefore it is highly probable that one should win. And secondly, physicists agree that "really improbable" are events beyond a probability of one out of 10,000,000,000,000,000,000,000,000,000,000,000,000 (this is $1 \bullet 10^{40}$). Although mathematically possible, it is absurd to believe that such an event could really happen in our universe (given the life span and the size of our universe).

The third assumption (Occam's razor) is helpful as long as there is no other indication for the validity of any of the competing theories describing a physical phenomenon. Prefer the simplest explanation unless there is a better one.

The law of causality, which is our fourth presumption, is sometimes misunderstood by philosophers and physicists as well. These misunderstandings often have to do with the category or "domain" where this law is applicable. For example, the well-known philosopher Paul Kurtz, coauthor of the *Humanist Manifestos* I and II,[1] asked the question, "Who made God?" during a debate with the Christian apologist Norman Geisler.[2] He pointed out that since God surely is an "effect" he therefore must have a cause. But this is a logical flaw

because the law of causality is only applicable within the category of things that come into existence. Since the God of the Bible is defined as to exist eternally, he could not have come into existence. And if something or someone exists and did not come into existence, he is not caused by anything. The cause of his existence must lie within himself. Because of such misunderstandings, it is better to formulate the law of causality in this more "redundant" way: "Everything that comes into existence has a cause." The law of causality refers only to the category of events which come into existence. The God of the Bible does not belong to this category.

There is no violation known of the law of causality. Even the existence of randomness or free will is no violation since randomness or free will concern only the tool for a result. So every freewill decision has a cause, namely the brain which performs it. Every random number has a cause, namely its "generator." The methods may be unclear (e.g., free will), but the law of causality is never violated. Another misunderstanding of the law of causality has to do with time. I will show later that this law is independent of time, it transcends space and time. Some people say that the law of causality is violated, e.g., in quantum physics. But this is not the case as we'll see later.

Last but not least, the fifth premise, namely that our contemporary science is the "best we have" and that it should be taken into account, is also very important. I will focus on this later on. In the following I will try to draw conclusions from the former premises and compare theistic and naturalistic explanations for relevant phenomena.

II. Logic and Logic—or: Where Does Logic Come from?

It is hard to find a naturalistic explanation for the existence of logic since logic is something that undoubtedly exits but is not material. Platonists believe that logic is "out there," and humans fortunately can recognize it. In contrast, naturalists often believe that logic is only created by the human brain in order to be able to coordinate the events we are experiencing in our life. Therefore logic has "evolved." Beside the fact that it is questionable what the survival advantages of mathematicians are, our physical universe seems to operate according

to logic, independent of the existence of human beings. Even naturalists believe that the universe "obeyed" certain physical laws long before human brains existed. And these physical laws are logical ones. So the question "Where does logic come from?" is hard to answer since there seem to be only two possibilities: either logic exists from eternity or it came into existence. If it exists from eternity, then it is not caused (premise 4) and the question where it came from is not applicable. If logic *did* come into existence once, it must have been caused. But does the law of causality apply at all to or within a world without logic? Since all our descriptions are logical statements themselves, it seems to be a kind of an endless regress to ask these questions. So let's deal with the evidence that is that logic *is* existing. (By the way, Christians have their explanation in John 1:1—see the quote at the beginning of this article). The most important thing within logic is the notion of truth. Mathematicians start out by *defining* basic truths (see e.g., Tarski's definition of truth). These so-called axioms are premises which cannot be proven true but which are evidently true (e.g., Euclid: "The whole is greater then its parts"). Tarksi's definition of truth (in fact he did not invent these laws but merely collected them) also includes the logical laws for the methods of mathematical proofs and inferring strategies. Mathematicians must not care if these truths are given by God or if they are the result of a two-thirds majority of a mathematicians' congress. But they stick to them, no matter what. This is the reason mathematical laws do not get out of time (in contrast to physical laws). Logic never fails. A friend of mine and advocate of eastern religions, who is a critic of our "Western thinking," once told me: "Everything exists with its opposite—this is the nature of perfection." I answered him that if it is true that everything exists with its opposite, then also does his statement. But the opposite of his statement is: "Not everything exists with its opposite," which must be true also. My partner accused me of leading him into a trap and terminated the conversation.

Conclusion 1: Logic is true (of course!).

III. Logic and Relativism—or: The Illogic of Moral Relativism

I once heard of a survey which says that over 60 percent of people do not believe in absolute truth. As a mathematician I am amazed by this result. I believe that 150 years ago almost 0 percent would believe such a thing (and nobody would have gotten the idea to conduct such a survey at that time). Within logic there is no such thing like "relative truth." The belief in the absence of absolute truth is a logical impossibility because of this: assume for a moment that there is no absolute truth. If there is no absolute truth, the statement itself ("There is no absolute truth") is not absolutely true, too. So it may be false. But in this case its opposite is true: "There *is* absolute truth." Hence we have inferred something with its opposite at the same time. The law of noncontradiction forces us to conclude that the original statement is self-contradictory and therefore false. So only its opposite can be true: there *is* absolute truth. A question for doubters: Is your existence an absolute truth?

This problem stands for an important characteristic of relativism: you end up very often with self-contradicting statements, which cannot logically be true. Consider, e.g., a statement I once heard from a liberal activist: "Since there are no absolute moral values, you ought to tolerate the relative moral values of other cultures." What sounds so nice is a logical flaw: the first part of the sentence presumes that no absolute moral values exist. In the second part you "ought" to do something, namely tolerate other moral values. But this is already a moral value itself! If the request "You ought to tolerate" is not an absolute moral value (according to the premise of the sentence), it must be a relative one. But then its opposite must be tolerated too! Imagine a culture which does not tolerate the moral values of other cultures (such a culture can easily be found). According to the second part of the sentence you ought to tolerate this intolerance, which is a direct contradiction to the statement. And if "ought to" is not a moral absolute, why should I "ought"? So the self-contradiction here is the demand to tolerate, which is an implicit presumed absolute and at the same time the statement says that there are no moral absolutes. To avoid such self-contradictions, you only can assume that there are absolute moral values! This is the only logically consistent

way. Otherwise you never could use words like "it is better if . . ." or "you should . . ." etc. accurately because if moral values are relative then these words can only express personal opinions and cannot be imposed on other people. An atheist recently said to me that there could be no "good" God because of all the evil in the world. But since my atheistic friend does not believe in moral absolutes, why is something really evil at all? It may be my friend's opinion that certain things *he* thinks are evil, but without an absolute reference point, why should God consider these things as evil, too? Why impose my own standards on God? Again, the admittance of the existence of evil in the world implies that there is an absolute measure for it.

Some object that a statement like "You are beautiful" is only relatively true since this is a matter of opinion. But this is not so because if two people would agree what the meaning of the word *beautiful* is, e.g., with the help of a long list which defines this word, they surely would also agree about what is beautiful. So this "relativism" is only lack of agreement concerning semantics. They simply don't mean the same thing when talking about "beautiful" things.

Last but not least, there are logical inconsistencies with moral relativism like these: Moral relativists proclaim that they are inclusive and nonpartisan. This, of course, is also a self-contradictory statement because they exclude the party of moral objectivists.

Conclusion 2: Moral relativism is self-destructive, while moral objectivism is logically consistent. There are only absolute truths.

IV. Logic and Quantum Physics

With the development of quantum physics a lot changed. Physical dualism was wrongly applied to philosophy and justifies postmodernism. Some even proclaim that the law of causality is violated. So let's try to straighten this out. First of all, physical theories always are made of three things: (1) physical presuppositions, (2) mathematical descriptions, and (3) logical/physical conclusions. If we assume that no mathematical errors were made, physical theories are wrong only when the presuppositions are wrong. And these presuppositions are based on observable data. If we assume further that the data are measured accurately, then we have two "unchangeable" components in

physics: Data and logic (mathematics). These two things are always accurate. How does it happen then that sometimes physical theories go wrong? This is because of additional presuppositions that are added to the measured data. Newton's law of gravity for example was based on accurate measures and accurate mathematics. But Newton assumed in addition that space and time are absolute (he had no chance of detecting otherwise at that time). Einstein used the same data and the same mathematics, but *his* additional presumption was that space and time are not absolute. This led to his famous theory of relativity.

Quantum physics is a mathematical theory which most accurately describes measurements concerning small particles. Since our everyday experiences normally do not recognize quantum-effects, our "commonsense" views the results of quantum physics as very strange. And here is the point where the law of causality comes in. Our premise number 4 says nothing about the order of cause and effect. Our common experience is that first comes the cause, later the effect. But this is not always so. Allan Aspect showed experimentally that cause and effect can occur exactly at the same time.[3] He produced two so-called "Twin-Particles," which are physically "entangled," i.e., they have certain common characteristics and are indistinguishable. Aspect directed these two particles in opposite directions, and the manipulation of one of the particles had instant effects on the other one, without any time delay. So here we have cause and effect with no time loss and independent of space. The quantum physicist Marlan Scully went even further. He proposed an experiment[4] that was carried out later, which showed that even the order of past and present can be changed for cause and effect. I want to give a rough overview here of the Scully experiment, to show how important its results are.

A light beam enters a crystal, which divides every photon in two so-called "twin-photons" with lower intensity (see fig. 1, next page).

The twin photons are directed in separate directions, each of them reflected by a mirror and later "united" by a semitransparent mirror (50 percent of the photons can pass through; the other 50 percent are completely reflected and therefore cannot pass through). Behind this mirror there are two detectors, able to register each photon.

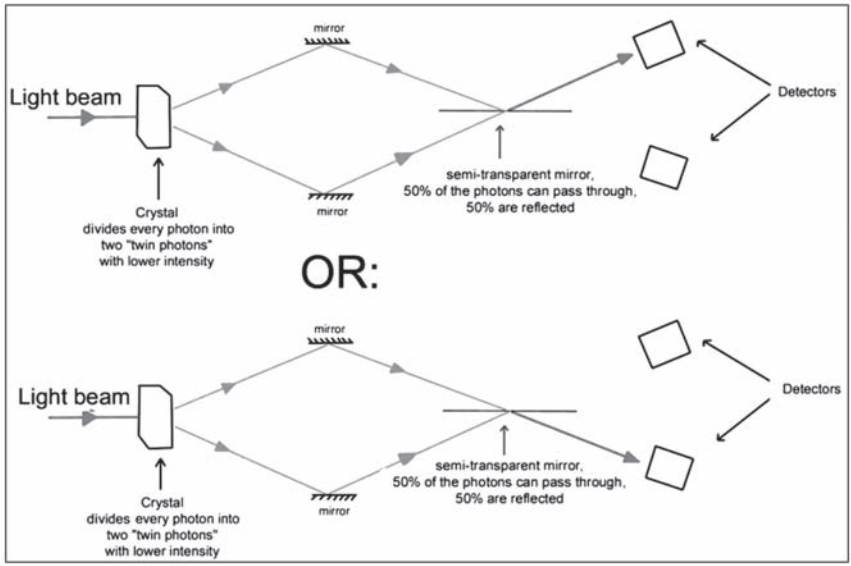

Figure 1: The Scully Experiment

Scully's arrangement of the components is made so that the twin-photons unite in a way, that at one time one of the twin photons is reflected and the other one passes through the semitransparent mirror or vice versa. In either case, as a result, a reunited, "whole" photon (with the original intensity) is detected either at the upper or at the lower detector. This represents the "wave-behavior" of photons and the effect is called "interference." Now the researchers were interested in finding out which one of the two twin-photons took which way before they were reunited at the semitransparent mirror. Therefore they "marked" one of the twin photons with a so-called polarization filter (see fig. 2). This is an optical device, which "twists" the photon-beam a little bit. In doing so, the photons "feel" observed and therefore their wave-behavior is destroyed. Suddenly there are not only "united" photons detected but also "single" twin photons at the upper and the lower detector at the same time.

But what happens if two other polarization filters are set up directly in front of the detectors, which are adjusted in such a way that "behind them" the information of which photon is marked (i.e., polarized) is deleted? (See fig. 3.)

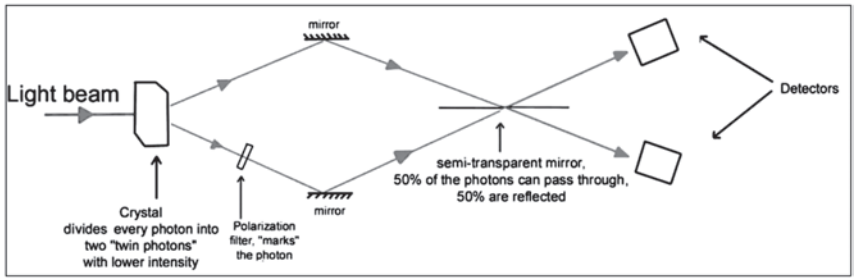

Fig. 2: Marked photons

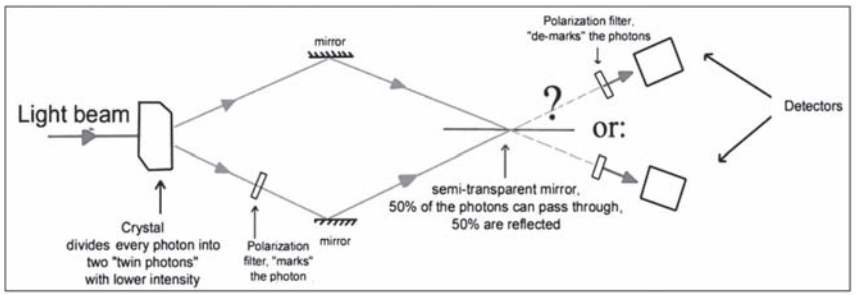

Figure 3: Marked Photons "Deleted"

Here is the amazing result: since the information has been destroyed (concerning *which* photon went which way) the photons no longer "feel" observed and therefore, as in the "undisturbed" experiment (without any polarization filters), there are only reunited twin photons detected, **either** at the upper **or** at the lower detector. So, the twin photons unite once again at the semitransparent mirror in such a way that either the one twin photon is reflected and the other one passes through or vice versa.

But wait a minute—how could the two twin-photons know that **behind** the semitransparent mirror (this means **later** in time) a device is waiting, which destroys the information of the first polarization filter and that for this reason the twin photons reunite at the semitransparent mirror? Can the photons foresee the future? Or does our measurement (i.e., observation) influence the past? If there is an independent reality "out there" (this means, independent from the observer), how could these results be explained? In fact, they couldn't! At least, with no "reasonable" explanations.

Still some scientists tried to do this, for instance, by declaring the existence of so-called "parallel universes" which all exist at the same time and are often very similar to our universe. In this model (founded by Hugh Everett in 1957), according to our experiment, there are (at least) two universes: one where at the semitransparent mirror the twin-photons are reunited and take the upper *or* lower way and one where they stay separated and take both ways. So both universes are supposed to have a true reality and at the moment, when we "look" at the result of our experiment, we decide which of the two universes we are "slipping" into (the one with the appropriate past).

But a lot of scientists feel it is unscientific to invent objects (like multiuniverses) *ad hoc*, which could never be directly observed, only for the purpose to justify a physical model or to explain results of an experiment. Another group of scientists hope, one day, to find so-called "hidden variables" which will connect the observed photons registered at the detectors with the twin photons, which are supposed to unite "in the past" at the semitransparent mirror. The problem with this is that in the whole realm of physics there is not one single example (up to now) of variables, which can "influence" an event in the past from the present. This, too, seems a very "artificial" way, and again it is only justified by the purpose to explain the results of the Scully experiment.

Another point is the "observer-chain." The who-observes-whom problem leads to an infinite regress. In this case, some scientists conclude that there *has* to be an observer "outside" the universe because otherwise the problem of how a universe could exist without an observer is unsolvable. Guess who this outside-the-universe observer could be!

Now, a critic could say, well, the time span between the semi-transparent mirror and the detectors is so short that the influence into the past can be ignored.[5] But this is no real argument because the Scully experiment can be "stretched" to cosmic dimensions! Indeed, there is a cosmic constellation, which destroys this argument.[6]

A so-called "quasar," a pulsating light source, which is "hidden" behind a big galaxy, is visible on earth by "bending" its light around the galaxy, billions of light-years away (see fig. 4). This is possible because according to Einstein's theory of relativity, a large mass (like

a galaxy) could work as a gravitational lens and therefore bend the light around itself. So the light of the pulsar is "doubled" by the gravitational lens, i.e., one beam comes from the right side of the galaxy to us, and the other beam comes from the other side. This is similar to our twin-photons in the Scully experiment.

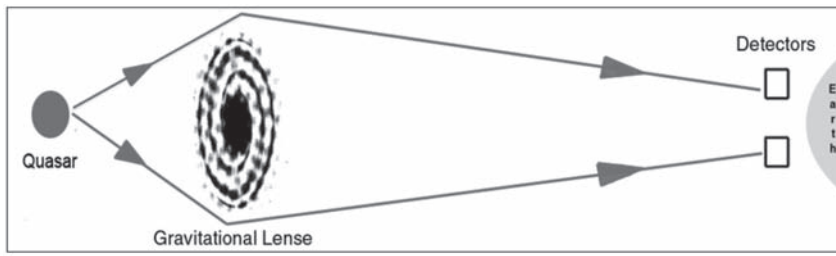

Figure 4: A Cosmological Two-slit Experiment

Without going into too much detail: on the earth an experiment can be made in such a way that it determines, if one photon comes along *either* the right or the left side *or* if it comes along both sides of the gravitational lens at the same time. But how could the photons have known billions of years ago that someday there would be an earth with inhabitants on it, making just this experiment? Or do we "influence" the past "out there" billions of years ago through our observations here in the present? Hardly imaginable! In addition, let's assume that different scientists perform two experiments of this kind at the same time here on the earth. One experiment is arranged in such a manner that the light beams pass both sides of the gravitational lens and the other experiment "forces" the beams to pass either on the one side or the other. So what follows? Are there two different pasts for each observer at the same time? This is *big trouble* for the multiuniverse theory as well as for the "hidden-variables" approach.

Let it be remarked that the older experiment of Alain Aspect was similar, but the question there was not if an observation could "influence" the past but if the observation of one of the two twin-photons could influence the other one through space instantly even at a great distance. The result was that they could with no time loss! But this contradicts Einstein's special theory of relativity, where the speed of

light is the absolute speed-barrier. While here some scientist's hope of ghostly "hidden" variables, which are capable of instantly transporting information from one photon to the other, was understandable, the existence of variables, which can transport information back in time, seems ridiculous. So it's no wonder that these scientists now feel a certain angst because of the possible loss of their weltbild.

Some may say that quantum physics, with all its strange results, doesn't matter in the macroscopic world since all the problems described above deal only with elementary particles. And indeed, in the macroscopic world we don't seem to have the problems mentioned here. But this is not *really* so. First, everything in our universe is made out of such elementary particles. And secondly, quantum mechanics is not only applicable to elementary particles; quantum mechanics can also be accurately applied to macroscopic objects. A well-known example of the strange behavior even in our macroscopic world is given by "Schrödingers Cat."[7] And furthermore, phenomena seem to exist in the macroscopic world which are not explainable with classic physics. For instance, some physicists try to explain certain ESP phenomena with quantum physics.[8]

Others say the conscious human is not crucial for the *reality* because a photographic plate could substitute the observer. Of course, this is no valid argument because, as corresponding experiments show, the results come into being (reality) when the photographic plate is observed by a human being. So this is only another example for the already described "observer-chain," since the time-point of the observation is only delayed to the observation of the plate.

According to the results of the Scully experiments, we now know that reality (at least as we observe it) can be a "construct" of our interaction with it, i.e., no one could really say what this reality "looks like" without our observation. And, as we've already seen, this even seems to be true for events that took place in a "past reality." So what can we *really* say about any events of a past, which were not observed by any human being (i.e., before the existence of mankind)? We can only say that our "reconstruction" of the past is an image, which obviously depends on our present observation of it. So the question: "what did the past *really* look like?" cannot be answered accurately as long as no observer was there. Remember, that the Scully experiment teaches

us that the past (of the photon's decision, "how" to unite at the semi-transparent mirror) was created during its observation in the present. But we also understand that this reconstruction of the past leads us to more than one possibility. The past's reality "happens" while it is being observed in the present, and the kind of observation even determines what the past looked like.

If one has seen the famous movie *Gone with the Wind*, then she knows which events took place. At first, there was the announcement of the civil war; then there was the war with all its destruction; meanwhile there was a love story going on and after the war the famous "Frankly, my dear, I don't give a . . ." scene took place. But was this *really* the order of the filmed sequences? Of course not! As everybody knows the sequences were filmed in an order, which was suitable to logistic and organizational demands. If, for instance, a person is only to appear three times during the whole movie, let's say at the start, in the middle and somewhere toward the end, then it would be easier (especially if the actor is costing the movie company lots and lots of money!) if all of these scenes were filmed at one time, if this is possible. Later these sequences are inserted at the proper position in the movie even if "years" lay in between (according to the plot).

Or let's take the TV series *Star Trek* (the one with Kirk and Spock, etc.). After this series was on the air, there were book authors who "constructed" a matching past to the series and wrote, e.g., about Spock's youth. So *in the present* a possible, "reasonable" *past* was created for Spock which led to the "reality" of the stories of the series in a logical way. So this reconstruction could be called an "extrapolation" from the present into the past. However there could be more than one possibility for Spock's past which matches the TV series! But remember, in *reality* (in the series) there was no "past" of Spock *at all*. And further Spock "exists" only if someone looks at one or more of the *Star Trek* series or movies. Therefore, in a sense Spock exists only by observation, not in reality! And as we know from the movie *The Truman Show*, even the reality of a "real" person could be a total fake.

Now what do scientists do when they are talking about a past where boldly no man has gone before? They are talking about an extrapolation of the present (of mankind) with three possibilities:

- The extrapolated past could have *really* happened this way.
- Another "reasonable" past could have happened.
- There was no *real* past at all (at least no kind of past that we can imagine).

The Scully experiment is a so-called "delayed choice-experiment" and takes advantage of the fact that every particle in the universe is surrounded by a "cloud" of uncertainty in respect to time and space. Subtle arrangements of certain components on a workbench result in a device, which produces an effect in the past caused by an event in the present. Hence, we can have (1) cause *before* effect, (2) cause and effect at the *same* time, (3) cause *after* effect, and (4) cause and effect independent of space. Evidently the law of causality transcends space and time (since the chronological order of cause and effect can be time independent and independent from the distance).

This has nothing to do with determinism. As Stephen Hawking pointed out, quantum physics does not give up determinism but does reestablish it.[9] Cause and effect is in place, but one cause can produce a given contingent of well-computable effects, and one of these effects is actualized in reality. Why (supposed) identical causes can produce different effects is not all clear. It may be that there is "true" randomness at work or that the causes were not really identical, since we cannot be 100 percent sure what really influences an experiment.

But what we must give up is a "clockwork universe" where one space-time moment of the universe can determine the next in a unique way. All previous and all future states of the universe are "only" one of a contingent of (in principle mathematically calculable) possible states.

Conclusion 3: The law of causality is a "meta-law," i.e., it is independent of space and time.

V. Quantum Physics and Infinity within the Universe—and What Free Will Has to Do with It

When quantum physics arose, more and more physical values turned out to be quantisized. Matter, energy, light, etc.—all have some kind of a "smallest" number possible, and every "lump" is a

multitude of this number. Newest results indicate that even "empty" space, and also time, is quanticized. The smallest part of empty space is about 10^{-33} cm "long," and the shortest moment in time lasts 10^{-45} seconds (Planck-length and -time). In school I once learned that irrational numbers do exist "in reality," although they have an infinite number of different decimals, e.g., the square root of 2. The "proof" was the following:

Take an x-y-coordinate system and draw a line between the numbers 1 on the x- and the y-axis (see fig. 5).

Then use a divider with the length of the distance between the

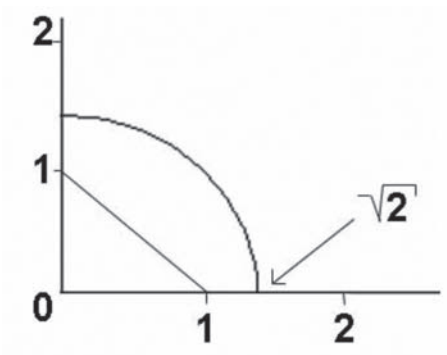

Figure 5: The "Reality" of an Irrational Number

two 1s and draw a circle around zero. The intersection with the x-axis (the real numbers) has the value of √2 and seems to exist in reality. But since every piece of space is a multitude of the Planck-length, it is not really possible to adjust the divider so that you can reach a point "within" a Planck-length. Therefore you can never find the exact distance for √2 in reality! There is no "infinite small" space in reality. Space is no continuum. The same is true with time. The "flow of time" is more like a movie composed of many single frames, and the time span between two frames is the Planck-time. There is also no infinity detectable on large scales. According to the big bang theory, the universe is expanding, i.e., it is finite at any given point in time. We can speculate if the expansion is going on forever, but there is no evidence of that; we must wait "forever" to be sure.

Scully's and Aspect's experiments show that under special circumstances reality seems to be created while observing it. But things are not as easy like that. One must differentiate what the notion *reality* means. First of all, reality is connected with our cognition. Our cognition tells us something about the reality we live in. This kind of reality I like to call the "physical reality." All that we can measure and perceive belongs to this aspect of reality. The Copenhagen interpretation of quantum physics says that this is the only reality physics can deal with, and it makes no sense to talk about any other sort of reality. The reason for such a statement is that with quantum physics we find another kind of reality, which I would like to call a "mathematical reality." Let's take again for example Schrödinger's famous cat. In this thought experiment the poor cat is caged in a closed box where some radioactive material is the trigger of a poisoning gas. The probability that the radiation activates the release of the gas may be 50 percent. If one describes this scenario with quantum physics, this leads to a mathematical equation, the so-called "Schrödinger equation." The solution of this equation is called a wave function. It shows that the cat is 50-percent alive and 50-percent dead *unless* no one "looks" at the cat. In this unobserved state the wave function is a "superposition" of two mathematical terms, where one term represents the living cat and the other the dead one. If the box is opened, the wave-function "collapses," and one of the two possible states becomes reality (either a dead cat or a living one). Mathematically this corresponds with the vanishing of the "death" or "live" term in the solution of the Schrödinger equation. But what should one make of the superposition of a 50-percent-alive and 50-percent-dead cat? According to human experience we always recognize either dead or living cats. The problem is that we cannot observe this obscure half-alive-half-dead cat since our observation always goes along with the collapse of the wave function, and this means the cat comes out dead or alive. The problem with this "other" kind of (50/50) reality is that no one can say how it looks, since "looking" means destroying this kind of reality (collapse of the wave-function). But what we have is a mathematical description of this kind of reality, and therefore I called it "mathematical reality," since no one knows how it *really* looks, although it can be mathematically described. According to the Copenhagen interpretation statements like "There is

no reality below the Heisenberg Uncertainty Limit" always must be understood as: there is no *physical* reality in the sense of my definition above. But there remains what I named the *mathematical* reality since the state of a quantum system could be described mathematically accurate. As I mentioned above, the problem is that no one can understand with "common sense" what kind of reality this should be. For to make an absolute statement like "there *is* really a reality below the Heisenberg Uncertainty Limit" or "there *is not* really a reality below the Heisenberg Uncertainty Limit" would presuppose that we were all-knowing God. So I prefer to state "there *is* a *mathematical* reality below the Heisenberg Uncertainty Limit" and what it *really* looks like—only God can say.

The application of what just was said I called the Divine Anthropic Principle.[10] Quantum physics tells us that the physical reality even of our past may depend on how we look at it at the present. Therefore extrapolations of a possible past before human observers exist is not as certain as it seems to be. We saw that theoretically a large number of different "pasts" is possible, which all could lead to the same "present" we are experiencing now. Of course, physics can accurately extrapolate and it does. But because of the mentioned ambiguity of possible pasts this may lead to different results, depending on the "tools" and theories used for the corresponding extrapolation. Let's illustrate this graphically. If we use any physical law, e.g., the law of entropy (horizontal axis, with a plotting scale so that entropy increases linear), we can demonstrate how large the extrapolation zone is:

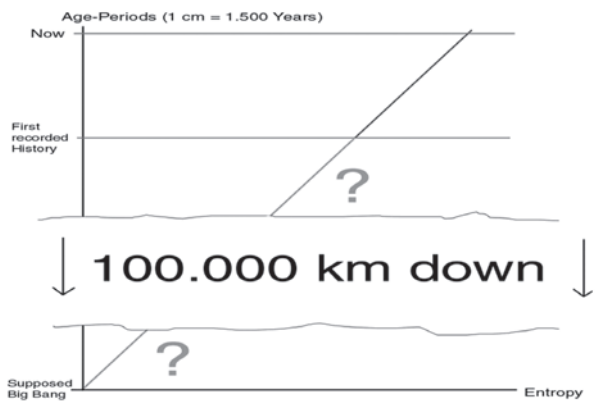

Figure 6: The "Far" Past

In Figure 6 one cm on the vertical axis equates with 1,500 years of time. We assume that the first *recorded* history appeared about 4,500 years ago (middle horizontal line). The lower part of the middle line must be extrapolated. And the relation is as follows: We have 3 cm of recorded history and over 100,000 km of (mathematical) extrapolation. We assume physics does this correctly, but another presupposition is (of course) that there is a *physical* reality "out there" where no man has gone before. On the other hand, the Scully experiments seem to show us that it is possible that how the past "looks" depends on the methods we use to observe this past *today*. Therefore past before mankind at least in part may have the quality of a *mathematical* reality as mentioned above. But is this all we can say? Of course not. The chances are very good that most parts of our calculated past reality are actual real physical ones.

In order to understand this whole issue of an ambiguous past better, let me lay out an analogy (for theists this could be God's perspective since the Bible tells us that God transcends space and time). It may also explain the role of the law of causality, which can be interpreted as a "geometric" property.

We saw that space and time seem to be quantized. Space is a set of little cubes of the size of the Planck-length, and time does not "flow" but "jump" like a set of movie frames with the Planck-time as time span between two "frames." (By the way: The physicist H. W. Beck[11] has good arguments to locate our self-awareness—or call it soul if you like—between the Planck-lengths within our brain). Imagine we could take a snapshot of the whole universe at every Planck-time from the start to the end of the life span of the universe. This would result in a series of snapshots (a kind of "movie of the universe"), which even vary in size (since the universe expands). Let's assume they all lay on a big table with no special order. A little problem is the fact that there are two kinds of reality, the physical one (which *really* happens) and the mathematical one (which we can't imagine with our common sense). The half-dead-half-living cat is such a mathematical reality. As a "working" model we can substitute such cases by thinking of a combination of *two possible alternative* physical realities instead of only *one* half-dead-half-alive reality (this is what the mathematical appearance of the corresponding terms suggests,

where in one of these realities the cat is dead and in the other the cat is alive). In fact, Hugh Everett's "Many World Hypothesis" is based on such a conception, but the difference to our model is that Everett believed that these alternative "pasts" have a real physical reality somewhere. To me this is an *ad hoc* hypothesis and not acceptable as a physical theory. Therefore we are talking only of two *possible* physical realties, and they must not really "happen" somewhere out there. In this sense our "movie" of the universe has to be extended by other "possible" movies. These other movies incarnate the physical alternatives according to the mathematical realities as mentioned above.

To simplify matter we assume that the pictures of all the "real" and "possible" movies are lying separated on the table in the following fashion:

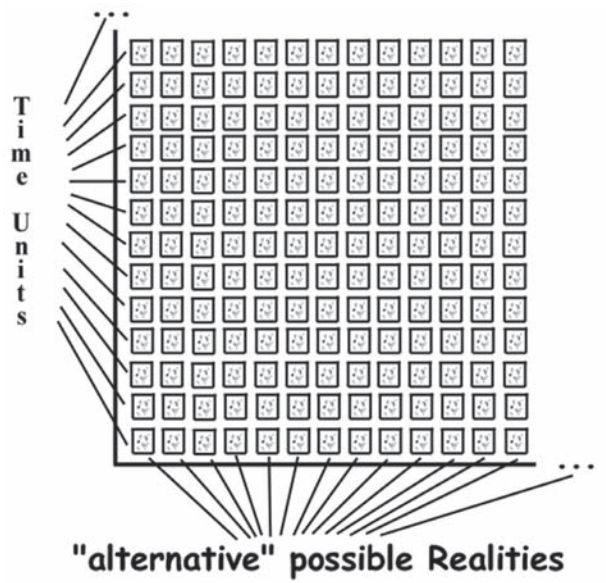

Figure. 7: Quantized Space-Time and Alternative Realities

The pictures are lying on the table in such a way that all pictures of possible realities are forming one horizontal line. The next upper line is made of pictures of alternative realities, which we (as human beings) would experience as the next elementary time unit. But remem-

ber: this "order" is only for the purpose of a simplified discussion, and it is *not* a necessary one!

In Figure 7 we see the pictures lying on the table (the table would be very huge so we see only a very small outcut). Every little square in Figure 7 is a "snapshot of the universe," which itself is composed of a large number of elementary space-cubes. The columns of Figure 7 represent alternative realities, and the lines represent different time-units. With the creation of physical laws, the set of possible alternative realities is restricted. If we assume that the lines of pictures on the table are arranged in a way that from the bottom to the (far away) top every line represents events, which according to the introduced physical laws are conclusive from time-unit to time-unit, then, e.g., the big bang must be one of the pictures of the bottom line. According to the big bang theory the "first" line at the bottom is probably only one picture of the size of only one elementary cube. If we go further upward more and more pictures appear with increasing size (amounts of elementary cubes) since the universe expands. But for our further considerations this could be neglected.

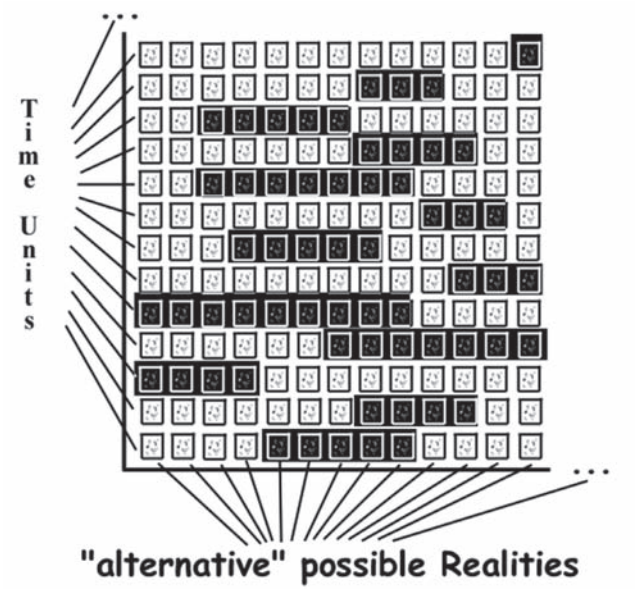

Figure 8: "Associated" Realities (Darkened)

So when physics is there, the collection of possible alternative realities is restricted in every time-unit-line according to the laws of physics and especially of quantum physics. Again only for simplifying matters we assume that such "belonging-together-realities" are lying next to each other.

The blackened areas on Figure 8 represent *mathematical* reality. If we would go along with classical physics, the classical laws of physics would force one to represent the universe as a series of always only one such picture per line (see fig. 9):

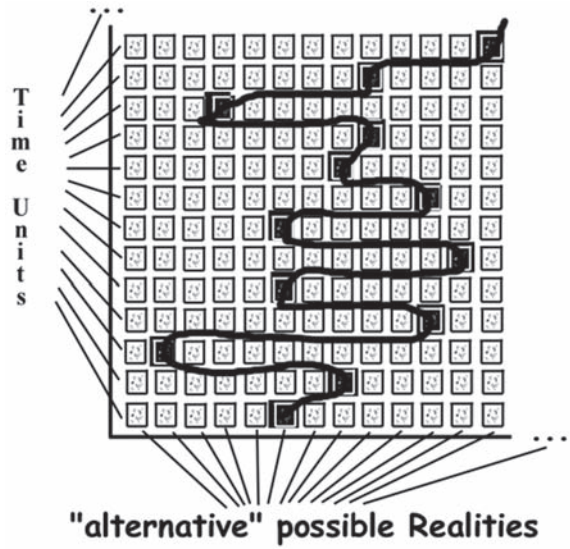

Figure 9: "Classical" Realities (Darkened)

Let us call such a line a "path." Within classical physics there would exist only *one* such path. This is the idea of a clockwork universe. This means that with physical laws every state (picture) of the universe is fully determined by the physical laws and the preceding picture (where the quantization of space and time is not necessary since the states of the universe were seen as continuous events). Of course, this leads to a regression where one only needs the first picture (e.g., the big bang) and the "right" physical law, which was called *Weltformel*. It was Einstein's dream to find this *Weltformel*. The idea was

that in principle one could calculate all events in the universe with this formula if one would know all the "input parameters." God was seen as the designer of this "clock," and He only had to wind it up, and He left it alone afterwards. But there arises a problem with free will. If the *Weltformel* predetermines *everything*, where is the place for a free will?

But quantum physics shows us a way out of this dilemma. Reality is no longer a predetermined unique path but a collection of possible paths (see fig. 10).

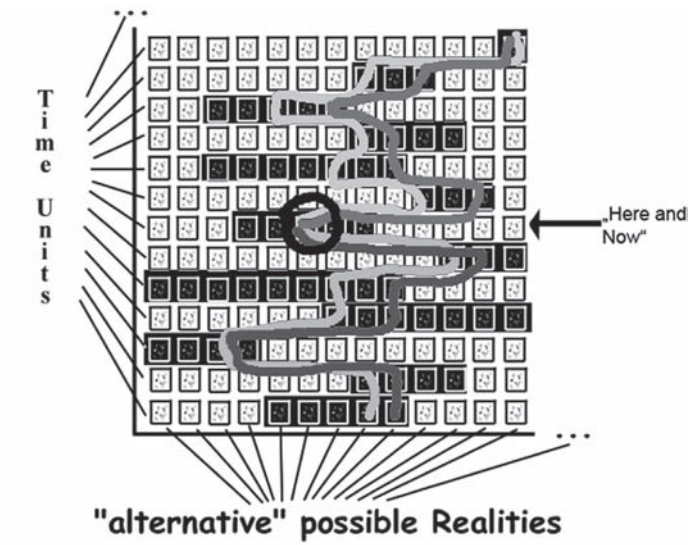

Figure 10: "Quantum Physical" with Alternative Paths

In analogy to what we earlier called mathematical reality, we call this collection *mathematical paths*. But what then does correspond to physical reality, the *physical path*? In some odd way the physical path is *not* physically predetermined, i.e., the complete path (from the actual time-unit in the present downward to the beginning of time) can change in dependence of some present and/or future events. Why? Because what *we* see is this: according to Scully's experiments it seems possible that a special *past* path is created at that moment when we perform a certain experiment (like Scully's) in the *present*.

Another drastic example is the cosmological two-slit experiment as mentioned above (see fig. 4): We choose *now* (through our free will by the observation method in the present) how the *past* does look. In figure 10 this is demonstrated by the different paths from present to past.

In accordance to the Copenhagen interpretation of quantum physics, it makes no sense to ask: How did the *physical reality* look in the past (when the light *really* passed the gravitational lens) since this physical past depends on the performance of the cosmological two-slit experiment *today*. The *mathematical reality* of this past is described by a superposition of two possible past realities: One, where a photon passed the right or left side of the gravitational lens (particle-behaviour) and the other one where the photon passes both sides at the same time (wave-behaviour). Unless no one "looks" at the photon, these two possibilities are part of the quantum mechanical description of this problem. This *is* the *mathematical reality*. It represents a gigantic "cloud of probability" of two possibilities. If someone "looks" at the photons, then according to the adjustments of the experiment, the *mathematical reality* "collapses," and one of the two possibilities becomes *physical reality* (remember that this reality concerns the long ago past). Uncertain past collapses into certain past. This is why we sometimes say that the past is created in the present. But this is not exactly true. The past is not created (by us humans), but it's rather "chosen" out of the possible mathematical realities. In a way our free will (e.g., the decision to perform a Scully-like experiment) determines not only (at least parts of) our present and future (as everybody knows), it seems *also* to choose or to determine (at least parts of) our past (which is hard to comprehend by common sense). But the distinction of future and past is only within our human perspective since we are bounded by time. In modification of the saying that our future is uncertain, we can say our past is also! Therefore from our perspective one of the several possible past paths becomes *the* (real) past path.

Thus the law of causality now gains a geometric nature. Like in the movie *Gone with the Wind* (as mentioned above), the series of sequences that determine the events in the movies are "cut" in the "right" order although they may not be filmed in that order. The "geometry"

of the frames glued together to a movie by the cutter determines what is causal while watching the movie. And maybe some filmed alternative sequences of a situation were discarded, and (the best) one was eventually actualised. In the same way the "path" of causality in our life may be determined by the geometry (i.e., the order) of the snapshots on the table in figure 10. Humans are limited to change this order only according to their free will within the boundaries of mathematical reality. Free will plus mathematical reality lead to physical reality in accordance with the laws of quantum physics.

In our model God can see all the pictures lying on His workbench. Since God is not bound by time, He sees all the pictures and events at the "same time." For Him the notions "beginning" and "end" have a more geometric quality since the beginning of our universe is associated with the bottom of the table and the end with the top. And somehow God also sees the final path! According to our (restricted) perspective this final path would be *the* real past we would see if we would look back from the very "last" time-unit of the existence of our universe (one of the pictures on the top line of God's table). Then the entire Scully and cosmological two-slit experiments etc. are preformed, and the past is finally determined. But until then the past is a kind of variable which may change (e.g., by future Scully experiments). But not for God. He is "outside" of time and space and therefore "knows the end from the beginning" (Isa 46:10). This is clear, since all events lie stretched out on His table. And not only this. He also "sees" what we called the final path "from the beginning."

A Remark Concerning Miracles

God is all-powerful, and therefore He is able to intervene in our life. This means that He can modify the path of the universe by changing its way. Since He sees "all" possible paths, He can intervene and "correct" the (final) path according to His plans (and perhaps our prayers etc.). To do so, He has the possibility to use a collection of "pictures" even "outside" the realm of what we called the mathematical reality. Or He could use power according to physics (in principle, one could physically "create" thousands of fish out of one or two by gathering molecules of air or sand and change their physical structure; the only problem is that one needs a huge amount of power and

energy not feasible to produce by our human technology). Anyway, it's His selection of pictures to modify and create the final path.

A Remark Concerning Free Will

We saw in our analogy that free will is possible since the past, the present, and the future are always a *collection* of possible realities. We further saw that even the past may be influenced by our free will in the present. Nevertheless God sees the results of our decisions since He sees the final path from the beginning (actually, there is no beginning for Him since He is "outside" of time and the word *beginning* is a time-dependent notion). So there is no longer a conflict between a free will and an all-knowing God. In a way this is similar to the possibility of time traveling. If you would have a time machine and you could "jump" a year forward and then back again, you would *know* what will happen next year although this future world is a result of lots of free will decisions. Therefore to *know* the result of a free decision does not mean that there *is* no free decision. The seeming contradiction between human free will and God's predestination is therefore solved, see, e.g., in Ephesians 1:5 (KJV): "*Having predestinated us unto the adoption of children by Jesus Christ to himself, according to the good pleasure of his will.*"

Conclusion 5: Infinity seems not to exist in physical reality; it is probably only a mathematical construct. Amazingly enough, we can "imagine" infinity and even describe it mathematically.

VI. Logic and First Cause

According to the big bang theory space and time (i.e., the universe and all that's in it) had a beginning about 13 billion years ago. We already established that *within* the universe everything that exists has a cause (since everything came into existence). But can the law of causality be extrapolated outside the universe? Since we found out earlier that the law of causality is a "meta-law" (i.e., it is independent of space and time), I would argue that there is no reason the big bang is not also caused (since it undoubtedly came into existence). It seems that the universe was caused by something is at least the more plausible presupposition. But what caused it? There are only two

possibilities: Either the cause was never caused itself (then this is the "first cause"), or it was the result of another cause. We can produce a chain by asking again if the cause of the cause was also caused or not. Finally there are only two possibilities: Either the chain of causes stops somewhere at the first cause, or there is an infinite regress of causes and effects. Let's investigate carefully the two possibilities. We look at the latter possibility first.

Theorem

A cause-effect chain can only have a finite number of causes and effects if time passes between cause and effect.

It is clear that an infinite number of even small time-amounts that pass between causes and effects would sum up to an infinite time span, which ultimately avoids our being here now. To illustrate this, imagine a bookshelf with a start but no end (see fig. 11).

If you push the first book (let's assume the beginning is at the left side), then a "domino effect" takes place, and a chain of falling-over

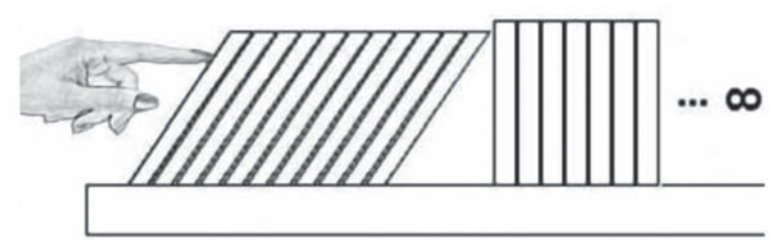

Figure 11: A Bookshelf with a Start, but No End

takes place which never ends (ideal circumstances assumed). This chain of fallings never stops since there is an infinite number of books and a small time span between the fall of every book and its neighbor.

Now let's assume there is a shelf which mirrors the one described, i.e., the shelf is turned 180 degrees to the left. Now we have a bookshelf that reaches from infinity (at the left) and has an end at the right (see fig. 12).

If somehow the falling-over of the books was "started" at infinity on the left, when will the last book on the right fall down? Never, of course, since it would take the same time span as in figure 11,

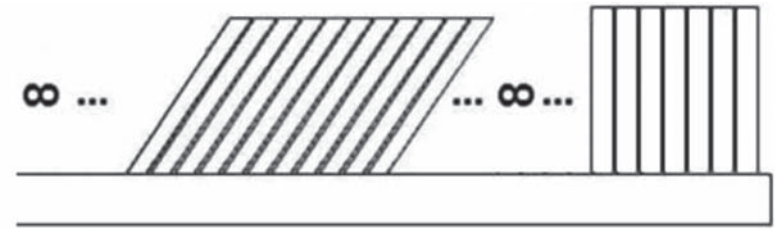

Figure 12: A Bookshelf with No Start but an End

i.e., eternally. If the last book on the right represents our here-and-now in a cause-and-effect-chain, it would never be reached, and you could never read this article.

So if we have an infinite cause-and-effect chain, an infinite number of causes and effects must take place simultaneously, and only a finite number takes place with time. But if we look at the conditions necessary to have a simultaneous cause and effect, we find that this is only possible if the objects are in a quantum physical state of "entanglement" (like twin photons). In terms of universes that caused each other simultaneously, we would need "entangled universes," which is physically never shown possible, and we would need an "outside" cause to start the "de-entanglement" process. This all seems very fantastic, and it is highly questionable if this is logically and physically possible at all. The same is true for the reverse order of cause and effect in delayed-choice experiments.

Another thing: We find physical infinity nowhere in our universe. Why in the world should we assume that there are physically infinite processes outside the universe? This is pure speculation with no evidence anywhere.

So obviously we are "stuck" with the other case: The cause-and-effect chain must be finite and therefore have a start.

Conclusion 6: The existence of a first cause is the most plausible assumption, far more plausible than its opposite.

VII. Logic and Statistics

Although some people think that statistics is the scientific form of a lie, I would argue that statistics is a tremendous tool to precalculate probabilities which really take place. That's how we live

our life. Since much literature is available, I only will mention two important things briefly: first we have the problem of fine-tuning in the universe. Not only are the basic physical constants *at* the big bang extremely fine-tuned in a way such that other physical values would disable the universe to carry life, but also fine-tuning *within* the universe to enable life is also very carefully chosen. The chance of being in the category of life-sustainable universes is almost zero, at least far beyond $1:10^{40}$, which is the physical "impossibility boundary."[12] Second, there is a thing called "specified complexity." As William Dembski showed, there is a mathematical method to determine if a complex structure is pure chance or if it is designed.[13] Applied to irreducible complex biological systems (like a cell), design seems the only plausible option.

Conclusion 7: The fine-tuning of the universe and irreducible complexity in nature is best explained by design.

VIII. Logic and God

What is more plausible, the assumption that there is no God or the one that there is a God? I would clearly argue that we have more problems if there is no God. According to our premise 3 (Occam's razor), the existence of God is surely the simplest and logically most consistent explanation for our existence. Take, e.g., the existence of moral absolutes (conclusion 1). They couldn't have evolved, since they contradict the "survival of the fittest" (e.g., it is morally "good" to help handicapped people). So where do they come from? And the first cause was the most plausible explanation for our existence. But who or what is the first cause? Because the first cause is not created, it must exist from eternity. Since time and space and matter etc. came into existence with the big bang, this first cause must transcend time, space, and matter and therefore must be spiritual. And if no time passes for this entity, how could it ever start a cause for anything (e.g., our universe)? A "deep frozen" timeless first cause would not cause anything else; how could it? A good explanation I think is the existence of a "will" of the first cause. But this means that the first cause is personal. And very intelligent (to create a universe like ours). If we look at the attributes above of the first cause, we'll

find that the God of the Bible is an exact match. Together with other well-documented evidence (e.g., the historicity of the rising of Jesus Christ from the dead[14]), we have a compelling cumulative case for the existence of the Christian-Judaic God.

Almightiness

Since logic is one of the attributes of the God of the Bible, he can only do what is logically possible. Hence there are certain things God cannot do; e.g., he can not lie (see Titus 1:2). The existence of evil in the world has its reason in this since God would have to become illogical to eliminate all evil (among other things this would clash with human free will). Therefore God's almightiness must always be seen in the context of what is logically possible.

Miracles

Because logic is a nonviolable attribute of God, all miracles must be logically possible. But this does not mean that they are also physically possible! As we saw, some events are simply physically impossible because they are very improbable. Take, e.g., the resurrection of a dead person. This is not a violation of logic but a violation of the second law of thermodynamics. If the atoms of a long dead person are recompounded again in a way that they resemble the once living person exactly, then the resurrection is accomplished. According to the second law of thermodynamics, this cannot happen by normal natural processes because the probability for such an event to happen "on its own" is far beyond $1:10^{40}$, which was the impossibility boundary for events in physics. If it happens, however, we must assume that a nonnatural power had intervened, and we call such a thing a miracle.

Conclusion 8: The existence of the God of the Bible is the most plausible and rational explanation for our existence, life, and redemption.

IX. Acknowledgment:

I would like to thank Dr. Warwick Montgomery for his outstanding life-work, which was an important step in my becoming a Christian.

Endnotes

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Peter Zöller-Greer was born in 1956 in Mannheim, Germany. He studied mathematics and theoretical physics in Siegen and Heidelberg. In 1981 he received his M.A. in mathematics from the University of Heidelberg. In 1990 he received his Ph.D. from the University of Mannheim for a mathematical solution to a quantum mechanical problem. From 1981 on he worked as a computer researcher at ABB Mannheim and as a lecturer at several colleges. Since 1993, he has been professor of mathematics and computer science at the State University of Applied Sciences in Frankfurt am Main, Germany.

About this Book

Tough-Minded Christianity is a collection of essays about the great work of John Warwick Montgomery (b. 1931), a living legend in the field of Christian apologetics who has earned eleven degrees in philosophy, theology, law, and librarianship, debated historic atheists including Madalyn Murray O'Hair, and influenced the work of such bestselling authors as Josh McDowell. Contributors to this volume include J. I. Packer, John Ankerberg, Erwin Lutzer, Vernon Grounds, Gary Habermas, and Paige Patterson, who asserts in the foreword that Montgomery did the "intellectual heavy lifting" to undergird the conservative renewal of the Southern Baptist Convention.

Also Available

Tough-Minded Christianity: Honoring the Legacy of John Warwick Montgomery (Entire Book)
Edited by William A. Dembski and Thomas Schirrmacher

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