Moebius

Volume 4
Issue 1 *(Un)Natural Disasters*

Article 5

4-1-2006

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Descartes never liked the idea that people think about infinities. Since we are finite, he said, it would be meaningless for us to verify anything concerning the infinite.[1] However, it turns out that the human mind, though limited, can consider the infinite. We know that when we divide one by an infinite number we get zero. It is like slicing a pizza pie into an infinite number of equal pieces. There will be nothing to eat at the end. We can have an idea of infinity even though our mind is not infinite and does not contain infinite knowledge. For the same reason, people might not like the idea that I question the existence of time; this could be seen as an attempt to define it in order to deny its existence. But does time really exist?

To come up with an experiment that could disprove the existence of time, we first need to know if time has an effect on physical things. Does the passing of time make people old, or do people get old regardless of time? People who don't take care of themselves look older than people who take care of themselves. For example, people who expose themselves to the sun get more wrinkles than people who wear protective clothing, use sunscreen, or stay indoors. The amount of damage to the skin caused by the sun is determined by the amount of radiation exposure and the person's pigment protection. In this case, we can state that the amount of radiation from the sun had an effect on aging. But is time relevant here?

If time is not relevant to our aging, then could our existence be timeless? The physicist Erwin Schrodinger once stated that Plato is famous although he made no special discovery about numbers or geometrical figures. What made him famous, Schrodinger declared, was the fact that Plato was the first to conceive the idea of timeless existence

Published by DigitalCommons@CalPoly, 2006

and to assert its reality as more real than our actual experience.[2] One might ask, what is an example of something that is timeless? One thing that comes to mind is that a mathematical truth is timeless; it does not come into being when we discover it. Yet its discovery is a very real event. One might argue that real numbers have no physical existence. They are a human creation and thus a product of biological and cultural creation. So a mathematical truth that involves real numbers can be itself a human creation. Pi is a real number. Is Pi a human creation? The Babylonians and the Ancient Egyptians discovered Pi a long time ago.[3] Pi is a mathematical truth. This mathematical truth is always true. It doesn't need time to exist. It doesn't need anything to exist. It was there in the void before we came into existence. It doesn't get old.

Once I attended a seminar in the Physics Department at North Dakota State University at which a colleague from the Chemistry Department made a presentation about corrosion, and how humidity and heat affect the paint of a car. He showed us pictures of a car and military aircraft with corroded paint, and spoke about how cars and planes could easily get corroded. I went up to him after his talk and asked him, "If I put a piece of metal in a vacuum, in empty space, will it get old?"

He looked at me and said, "Get old or get corroded, which one do you mean?"

I said, "Get old."

He thought for a moment and replied, "I don't know."

If, for example, we take a piece of wire and put it in a pure vacuum, will it get old? If it gets old, how does it get old? A piece of metal is a collection of protons, neutrons and electrons. Will the protons, neutrons and electrons get old? In general, does an electron get old? Physics tells us that an electron that was made billions of years ago after the Big Bang is the same electron today. The electron has an intrinsic energy that is always constant regardless of time. The electron also has an intrinsic spin that is related to this energy.

Now, the reason I am interested in spin is that the strength of the electron's spin doesn't change. It is independent of time. Physics tells us that the strength or the magnitude of an electron's spin yesterday is the same as the electron's spin today. So why doesn't time affect spin? We are made of electrons. We grow old and die, but the electrons in us don't grow old and die. We are made of something that doesn't die, but we corrode and die. Do we grow old because of time or because of the change in the mechanism that runs our bodies? We say that we grow old because of time, but why don't some particles grow old? Gold doesn't grow old. Gold is always gold. Metals don't get old; they get corroded. If, as I said before, I put a piece of metal in a vacuum away from radiation, humidity and other corrosive factors, the metal will not get corroded or grow old at all. It will stay the same. Where is the effect of time?

We need to ask ourselves where the idea of time came from. In 1995, I met Murray

Gell-Mann, the father of the quark model and Nobel laureate, at a talk held by the University of Minnesota Physics Department. He came to the Theoretical Physics Institute to promote his book *The Quark and the Jaguar*. I asked him an innocent physics question: Where did the Big Bang start? He answered me by saying, "You cannot ask that question because there was no space before the Big Bang, which means there was no where." He also said that there was no time before the Big Bang, so there was no when.[4] If time did not exist before the Big Bang, was the idea of time created?

If time was created, does it have a physical property, like matter? Why is it important to find out whether time has a physical property? If time has a physical property, it might interact with matter. For example, we know that matter is physical. If you see a car coming at you, you move away because if you don't, the matter of that car will interact with the matter of your body. If time has a physical property and interacts with other physical properties, its interaction will be real and the consequence of that interaction will also be real. Time, in this case, might interact with matter and space, and our understanding of these interactions will be based on something that really exists physically and not on something that is the product of our imagination.

Usually things that exist in a physical world will interact with that world. If time physically exists in this world, it would interact with this world. If time really does interact with this world, it does so differently than other physical entities, such as matter, interact with this world. Take the idea of time reversal. Think of it as if you ran a movie backward; nothing physical happens to the actual film. Physicists agree that time reversal does not affect any physical process. In all the laws of physics that we have found so far, there doesn't seem to be any distinction between the past and the future. The laws of physics still hold even if a physical process goes backward in time. There is a one-to-one relationship between a process and its time reversal. If a dish falls down from a table, it can go back up onto the table as long as you give back the energy lost to the act of falling. But if you take away some of the energy from the dish-table system, the physical laws of Nature will not allow the dish to return to the table and sit on its surface the same way it was sitting before the act of falling. Physicists assigned this time reversal phenomenon the letter "T". It is like an operator that acts on a process and changes it; it will make time run backward. If this "T" acts on a car moving forward, the car will go backward.

Now we can return to the question: How can we prove that time is physical? In general, if a scientist wants to prove that something is physical, he or she needs to make an experiment or write a theory that will be tested by an experiment. But the first step is to consider probabilities. To prove that an atomic particle exists, for example, a scientist needs to first calculate the probability for such a thing to exist. Unfortunately, almost anything has a probability of existing.

You might not believe this, but there is a probability for a bunch of monkeys to write the Great American Novel. If ten monkeys have ten computers and we show them how to type on the keyboard without teaching them English or any other language, the monkeys will type the Great American Novel, but it will take them a long time. They have to keep on typing letters for millions and millions of years. The important thing, however, is that there is a probability for the Great American Novel to be written by a bunch of monkeys. This sounds strange, but mathematically there is a probability that it can happen. As I said before, if we want to calculate that a particle exists in an atom, we must calculate the probability for it to exist, and that is exactly what we do now in quantum mechanics. We only calculate probabilities. Quantum mechanics does not tell us where exactly a particle is, it only tells us a region where it can be. So we might state that if we want to know if time exists we need to calculate the probability for it to exist. And even if we find some probability for it to exist, it will be like we have calculated the probability for it not to exist, because if we take the number one and subtract from it the probability that time exists, we will find the probability for it not to exist. Finding the probability is good but not good enough.

To prove that time exists or doesn't exist we need to conduct an experiment. We can do a theoretical calculation, but if an experiment doesn't support it, the theory becomes just an idea or a model and that's all. It doesn't mean that the theory is wrong or the idea is wrong; it just means that the theory cannot be fully trusted. Scientists usually do not trust a theory that is not supported and verified by experiment. Scientists used to think that light needed a medium to propagate in space, the same way sound needs air to propagate from a musical instrument to your ear. When you say the word "go" for example, your vocal cords exert a small pressure on air and that pressure propagates in the form of a longitudinal wave through the air in a somewhat similar fashion to water waves, which are transversal in water when you drop a stone onto its surface. If there is no air or a medium such as water or the ground, the sound will not be able to travel, and therefore it cannot be heard regardless of how loud you yell. Because of this, and probably other reasons, scientists believed that light might also need a medium, called ether, to travel. Light propagation turned out to be quite different than sound propagation. Light is a photon or a bundle of energy that travels in space with the help of two fields: one electric and one magnetic. In some orientation in space, the electric field oscillates vertically and the magnetic field oscillates horizontally. They both oscillate in the same fashion as light is propagating through space. The inclusion of ether was a model, and scientists needed to conduct an experiment to prove whether light needs ether to propagate in space. Two scientists Michelson and Morely proved that light doesn't need ether to propagate in space.[5] Is time similar to either sound or light?

As stated in Schrodinger's book *What is Life?* Ludwig Boltzmann believed that time has no direction; time is just a group of statistical considerations.[6] If we take a deck of cards that is ordered (i.e. 1, 2, 3, 4, 5, 6, 7, 8, 9, 10) and we shuffle it once or more, the set will turn into some random set (e.g. 2, 3, 8, 6, 1, 7, 5, 9, 4, 10). But this is not an intrinsic property of the process of shuffling. If we get a set of cards that is in disorder, a process of shuffling can cancel the effect of the first shuffling and restore the original order. In our example, the arrow of time is not worked into the mechanisms of interaction represented by the mechanical act of shuffling. This mechanism does not make use of the notion of past and future; it is in itself completely reversible. The arrow, the very notion of past and future, results from statistical considerations. In our example with the cards there is only one, or a very few, well-ordered arrangements of the cards, but billions and billions of disorderly ones. If we keep on shuffling the cards we can get back to our one to ten ordered set. Some clever people opposed this idea and wondered: If the shuffling of cards is symmetrical, why is the whole system going in one direction? Boltzmann found the answer; we need more time. If we have enough time we can get back to the set we started with. Boltzmann maintained that if the universe is sufficiently extended and exists for a sufficiently long period, time might actually run in the opposite direction in distant parts of the world.[7] Schrodinger agreed with Boltzmann by stating that on a very small scale, both in space and in time, such reversions have been observed in Brownian movement.[8]

This is not a new idea. As stated in G.J. Whitrow's book *The Nature of Time*, according to Nemesius the Stoics believed that Socrates, Plato and each individual man will live again with the same friends and fellow-citizens. They will go through the same experiences and the same activities. Every city, village and field will be restored, just as it was. And this restoration of the universe takes place not once, but over and over again, indeed for all eternity without end. The Stoics believed that those of the gods who are not subject to destruction, having observed the course of one period, know from this everything which is going to happen in all subsequent periods. There will never be any new thing other than that which has been before down to the minutest detail.[9]

However, Einstein did think of something new. In his theory of relativity, Einstein took time as a given and worked with it in his thought experiments. He found that time can be written in terms of a unit-less number called gamma. If the velocity of an object changes, then the gamma changes, and time changes. Einstein realized that time is no longer an absolute background stage on which events are played out, a stage unaffected by the events as Isaac Newton proposed. Einstein determined that time is derivable from physical processes and hence affected by them. To explain it simply, time in Einstein's point of view became like a rubber band; time stretches and compresses depending if the objects studied are going relatively fast or slow in space. In my theoretical calculation, I took Einstein's time and I added an imaginary term to it, and plugged it back into Einstein's equations to see if the Special Theory of Relativity would reject my added imaginary term of time. I found out that the imaginary term that I had added in the beginning to Einstein's equations did not have to be zero, which means that Einstein's equations allow time to have an imaginary part. Stephen Hawking stated that physicists are using imaginary time in quantum gravity.[10] If time has an imaginary part, can time itself be imaginary?

Finally, we can think of time and events as two parallel lines. One line is called the line of events and the other, parallel line is called the line of time. We can assign a time "t" for every event. In fact, we can assign two, three or even more events to one time. Two things can happen at the same time; for example, two planes can land at three o'clock in the afternoon: Plane A can land at three o'clock and Plane B can land at three o'clock. But can we assign two times to one particular event? Can Plane A crash at an airport at three o'clock in the afternoon on January 10, 2006 due to strong winds from a major storm, and Plane A also crash for the same reasons at four o'clock in the afternoon of the same day, and have this be the same particular event? No, one particular event with specific conditions cannot possibly happen at two different times. In other words, we cannot assign two different times to the exact same event. Why can we assign one time to two events, but not one event to two times? This is a simple question, but it is hard to answer. Normally, we use time like a tape measure. We need to know when events occur in the same way we need to know the length of something. A tape measure measures a length as time measures an event. We can assign two objects one length, but we cannot assign one object two lengths. There is parallelism between two ideas here. We created a tape measure to measure the length of an object. In the same way, did we create time to measure an event?

Einstein found out that time stretches like a rubber band. If we stretch a tape measure, does the thing we are measuring change? No, the thing we measure doesn't change. What changes is our reading of the tape measure. When we use time to measure an event, does the event we are measuring change? No, what changes is the time we read on our clock. If we stick to this parallelism, we know that we created the tape measure to help us measure and build things. Is it true then that we created time to help us know when events occur? We know that the tape measure is not tied to the object we are trying to measure. If a tape measure were tied to an object, we would never know the exact length of the object, because if the object changed, the tape measure would change too. If we change time, we know that the order of events doesn't change. If the order of events changed, we would violate causality, which means you could be born before your mother, or the fallen dish could reassemble its shattered pieces and return to the tabletop. Of course, these do not make sense. The reason we cannot violate causality is because time and an event are two independent things, just as a tape measure and an object we try to measure are two independent things.

So, as we expand our minds to try to understand the concept of time, are we any closer to an answer? Does time really exist? You must decide. The question is out there; you can provide the answer. I think Descartes was wrong about the meaninglessness of considering the infinite. Can we slice a pizza pie into an infinite number of equal pieces? Sure. We just have to remember not to slice that pizza pie so thin that we end up with nothing to eat. Is a philosophical quest for the reality of time worthwhile? Definitely. After all, how else will we know just how far we can stretch that rubber band?

Notes

1. James Gleick, *Isaac Newton* (New York: Pantheon Books, 2003), 40.
2. Erwin Schrodinger, *What is Life?* Cambridge, University P., 1967, Chapter on Religion.
3. Gay Robins and Charles Shute, *The Rhind Mathematical Papyrus* (New York: Dover Publications, 1987), 45.
4. Personal Interview, Murray Gell-Mann, 1995.
5. Steven W. Hawking, *A Brief History of Time* (Toronto: Bantam Books, 1988), 20.
6. Erwin Schrodinger, *What is Life?*
7. Erwin Schrodinger, *What is Life?*
8. Steven W. Hawking, *A Brief History of Time*, 64.
9. G.J. Whitrow, *The Nature of Time* (New York: Holt, Rinehart and Winston, 1972), 15.
10. Steven W. Hawking, *A Brief History of Time*, 139.

Additional Notes

I would like to add special thanks to Ramin Daghigh from the University of Winnipeg, Canada, and the *Moebius* Editing Staff. The idea for this article's title came from Palle Yourgrau, *A World Without Time* (New York: Perseus Books Group, 2005), page 108.