

Ignoramus and Ignorabimus

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A physicist sat on a beach one evening watching the sun set in a summer breeze. The silhouettes of a father and his son eclipsed the red giant over the horizon. Human noises punctuated the numbness of the air. The tired sun finally submerged beneath the crimson tide. The physicist thought to himself, "Why is the universe beautiful? God could have made sunset beautiful but the idea is too banal. If there is a God, why is there so much suffering in the world? Will my work ever alleviate suffering? If I were God, how would I do things differently?" The physicist disdained the religious overtone of his questions. He took one last look of the drooping darkness and resigned himself to the confinement of his office behind closed door—away from nature and human conundrums.

Many physicists start out as truth seekers aspiring to solving important problems (physics problems, world problems or whatever else deemed important). Physicists have a reputation of being smart. The profile of an intelligent person often includes fierce independence as a personal trait. The strength of independence is that it gives the physicists the willingness to go against conventional thinking (both inside and outside of physics) and the readiness to make new paths. The weakness of independence is that the physicist may neglect the lessons of history so that his creative energy is wasted in re-dressing old heresies in new suits.

Genius is no guarantee to scientific discovery. The obvious fact is that there are always many more geniuses than discoveries at any given time. History of science teaches us that discoveries are dependent on many factors other than intelligence, such as politics, technology, serendipity, character and sometimes luck. Some things are probably not meant to be known. Part of what it means to be wise is to know when we have reached our limitation. The Latin maxim "ignoramus et ignorabimus" meaning "we do not know and will not know" was coined by a German physiologist Emil du Bois-Reymond in 1872 to refer to the limits of scientific knowledge. The topic of this year's FXQi essay competition is "What's Ultimately Possible in Physics?" Philosophers analyze the limit of physics in terms of its methodology (ignoramus). Karl Popper says that science cannot tell us what things really are but only what can be falsified. Thomas Kuhn says that science is a political battle between the established scientists and the newcomers. Normal science (status quo) dominates until an intellectual crisis emerges and then a paradigm shift ensues. Paul Feyerabend says that there is no such thing as a scientific method. Scientists invent tools on the fly so that "anything goes."ⁱ Physicists think of the limit of physics in physical terms, such as the limits imposed by the speed of light and Heisenberg uncertainty principle (ignorabimus). Calling these physics principles the limit of physics is no more meaningful than to refer to the limit of the Newton gravitational constant being a

particular value and not another. The limit of physics and the physics of limit are sometimes used synonymously because of the physicalist assumption that the universe is closed and that there is nothing outside of the physical world. The identification of the limit of physics with the physics of limit leads to a tautology. The physics of the limit of physics is itself limited by virtue of being physics. Therefore one can ask what is the limit of the physics of the limit of physics and so on. This tautology leads to an infinite regress. A physicalist description of the limit of physics is therefore problematic. Limit is a relative marker in the sense that I am here but there is some place out there that I am not allowed to be. The limit of physics makes sense if and only if I know what is out there. We cannot know what is out there when we stay inside the limit. Physics is a study of all physical entities “inside” the physical universe. Therefore the investigation into the limit of physics requires us to go outside of physics from the natural realm to the supernatural realm. This essay discusses the most important kind of limit of physics commonly overlooked by most physicists—i. e. the limit caused by the neglect of the supernatural.

Physics (particle physics and cosmology in particular) tries to answer the questions of the origin of the universe and the fundamental nature of space, time, matter and forces. Biology (sometimes referred to as a branch of physics in some biology textbooks) tries to answer the question of the origin of life. The immediate goal imposed on science by the taxpaying public is to build a technocratic society free from poverty and disease. In religion, heaven is commonly thought to be a place that has all the answers and none of the pain. In a sense, the scientific utopia is heaven on earth. Historically scientists compete with religion (Christianity in particular) to create heaven on earth minus God. The idea of man evolving to be like God through science has either been coyly hinted or boldly stated by some physicists. For example, Catholic historian of science Stanley Jaki once wrote these words about some physicists,

“It is not the place to quote utterances of Eddington, Oppenheimer, Weinberg, Gell-Mann, Hawking and other prominent physicists who specified time and again their main goal in words that are so many variations on a memorable dictum of Einstein. His was the hope that his Unified Theory would be such that even the good Lord could not come up with something better. ... When a sense of superiority over the real takes on a measure in which the universe itself is engulfed only foolhardy minds would refuse to sense the reply of a hubris which in the first place was motivated by the lure of ‘you will become like gods.’ A Luciferian undertone may be hiding in Hawking’s recent encomium of the inflationary theory that he ended with the question: ‘What place then for a Creator?’”ⁱⁱⁱ

Freeman Dyson is much more politically correct about his view of scientific theology:

“God is what mind becomes when it has passed beyond the scale of our comprehension. God may be considered to be either a world soul or a collection of world souls. We are the chief inlets of God on this

planet at the present stage in his development. We may later grow with him as he grows, or we may be left behind.”ⁱⁱⁱ

Frank Tipler borrowed the term “omega point” from theologian Teilhard de Chardin to say that the universe is a cosmic computer that will combine all of the souls in the universe to form a cosmic consciousness in the Big Crunch.^{iv} So far these statements by physicists seem to err more on the side of mysticism than Luciferian blasphemy. Various surveys show that the majority of physicists are either atheists or agnostics. In my experience, most physicists are uneasy or uninterested in making statements about God. However the lack of the mention of God does not preclude the desire of wanting to be like God. The temptations of most intelligent person are often omnipotence and omniscience (the unique attributes of God). According to the Bible, Satan was originally an angel ministering around the throne of God. He became proud and wanted to be like God. Ultimately he was cast from heaven because of his pride and became what is later known as the fallen angel. In Genesis, Satan tempted Adam and Eve by telling them that eating the forbidden fruit would make them wise as God. The biblical account is full of stories of creatures wanting to become the Creator God. Physicists, like any other human beings, are not immune from the same temptation. Since atheistic physicists have no need for the “God hypothesis” and are actively building tools to perform the functions of God, it is not surprising that conservative theologians refer to the scientific ideology as scientism and treat scientists with utter suspicion.

The rift between the physicists and the religious sectors of the society constitutes a limit of physics not only in terms of the taxpayers’ money but also in terms of building a political barrier around the physics ideas such that physics cannot achieve the level of cultural impact in the society as it should. In America, some physicists use the separation of church and state to ban religious thoughts from physics. The recent controversy of evolution versus intelligent design rears the ugly head of an ideological battle between science and religion once again. The separation of church and state pertains to politics and not metaphysics. If God really exists and the universe is His creation, the logical conclusion of the physicists is to find out how God did it. Physics as a supposedly objective scientific discipline should not take side between atheism and theism. Unless the physical evidence overwhelmingly points to atheism, there is no reason to favor atheism in lieu of theism based on scientific considerations alone. To show an ideological bias to physics conclusions is to limit the options and to impose an artificial limit on physics that need not be there. Some physicists say that religion speaks about value and morality and are therefore outside the domain of physical science. This statement is itself a value judgment and not a scientific fact. The simple logic is that, if God is contingent on the physical universe (and I think He is), religion and physics overlap. Therefore interaction between physics and religion is legitimate despite the separation of church and state. Very often scientific discoveries are made when physics interacts with other disciplines (such as biology). In cross-discipline research, physicists are forced to think

outside of the box. It is conceivable that theoretical breakthroughs can be made when new ideas in physics are shaped by old ideas in theology.

A final theory in which all forces are unified into one force is a holy grail of physics. If this effort is successful, it will be a hallmark of human omniscience on par with re-creating God in the mind assuming that God and nature are one as some physicists think. In the history of physics, breakthroughs were made when forces were unified. Electricity and magnetism were unified into electromagnetism in Maxwell equations; the weak force and electromagnetism were unified into the electroweak force in the GWS (Glashow-Weinberg-Salam) theory. It was simply assumed by almost all physicists that this trend will continue indefinitely for all known forces. For aesthetic reason, it is much more beautiful to have one theory for all the known forces than to have different theories for different forces. Nevertheless physics itself does not demand a grand unified theory (GUT) except that GUT is likely needed for the big bang theory because it is reasonable to assume that all forces are unified in a singularity. Traditionally gravitation and quantum mechanics defied any attempt to construct a mathematically consistent theory—i. e. a theory without any uncontrollable divergence. Superstring theory became a hopeful candidate for the final theory when it was shown that gravity naturally emerged from it. Despite the big push for superstring theory, many prominent physicists were uneasy with the development. The common criticisms of string theory are the lack of prediction for experiment and the exploding number of possible versions of string theories. String theorists referred to the “landscape” to describe the large number of possible string theories. Finally Nobel laureate David Gross, one of the leaders of string theory, declared in the 2005 Solvay Conference that string theory was in utter confusion. He said,

“Most importantly, we do not know what string theory really is. When we say ‘The theory leads to ...’, we do not really know what we are talking about. We have many, often totally different, ways of describing approximate solutions to string theory; but what is string theory? We do not know the basic formulation of the ‘theory’, to which all of the these different dual descriptions are approximate. I am beginning to wonder we might be coming to the conclusion that string theory is inherently incomplete.”^v

Gross reiterated the same statement again in a recent interview with University of California Television on April 29, 2009.^{vi} There was a time when 10 to 20 string theory papers appeared on the web archive every day. Today they are down to several a day at best—sometimes none. If paper count means anything at all, it shows at the very least that the race toward a final theory has lost steam in the last few years. When Gross was asked whether the end of physics is imminent, he referred to the time that an entry level theoretical physicist needed to become productive as a measure of how close we were to the end of physics. He sounded optimistic that there were still enough things for physicists to do. The Large Hadron Collider (LHC) has just turned on in Europe. Particle physicists will be kept busy for about a decade or two. As long as there are data to analyze,

theoretical physics will be able to continue its funding. But funding is not the sole measure of the health of a field. If LHC does not find any new physics such as the discovery of Higgs, supersymmetry or extra dimensions, the fate of high energy physics will be very uncertain. Physics is in a sort of crisis both in terms of funding and direction. A leap of faith from physicalism into extra-physicalism can very well usher in a new frontier of physics.

In theology, the idea of unification stems from the need to systematize biblical data. Like physics, unification in theology is plagued with many conceptual problems. Theologians have thought about unified theories such as the hypostatic union of Christ (the unity of the Christ's divine and human natures) and the trinity (the unity of three Persons in one Godhead) for more than two thousands years. Theologians have the experience but they do not have the precise language like physicists have mathematics. Physicists tend to be terse. Theologians on the other hand are much more loquacious. Los Alamos physicist Stan Ulam used to say that everything worth saying can be said in 50 words or less.^{vii} Physicist-turned-theologian John Polkinghorne also said that he could use many fewer words to say the same things than other theologians. Mathematics is not only precise; it also comes with theoretical structures by default that can be used to model the structures in physical theories immediately. In fact God could be a cosmic mathematician who laid the foundation of physical laws in mathematics. If God is a master geometer like Einstein has said, then theology will benefit from using the language of mathematics (God's language). The way theologians can use mathematics is to use physics analogies to discuss theology. On the other hand, precision is only possible if and only if we know exactly what we want to say in closed form. As we approach the limit of physics, we often do not even know what to think. Therefore the exactness of the mathematical language may easily lead to highly specialized rabbit trails down into theoretical blind alleys. When we do not know what we are talking about, it is helpful to take a step back to look at the forest instead of the leaves by thinking in more general terms with common language to develop the proper attitudes. Loquaciousness is perhaps the proper technique for developing attitudes. Proper attitudes constrain the theory space so that theoreticians do not waste time populating the theoretical landscape as in the case of superstring theory. Thinking in general terms is what theologians have done with the hypostatic union, trinity and many other obscure concepts. In the same way, as we approach the limit of physics, we ought to develop an intuition first by using philosophy and theology. Under the auspices of meaningful interactions, the integration of physics and theology is likely to be mutually beneficial.

The Apostle Paul said, "For since the creation of the world God's invisible qualities—his eternal power and divine nature—have been clearly seen, being understood from what has been made, so that men are without excuse" (Romans 1:20). Nature falls under the category of natural revelation in theology but is also the domain of physical science. Therefore Christianity is very much for science. Some of the conflicts between science and religion do not come any more from

the antiscience sentiment of the Christians than the pseudo-science statements that some scientists make regarding open questions on the origin of life and the cosmos. Science is a way of looking at nature as much as natural theology. Science and theology can be complementary ways of looking at the creation.

Both physics and theology are interested in the concept of unification. The difference between summation and unification is that, as an example, for $C=A+B$, C is 50% A and 50% B in the case of summation while C is 100% A and 100% B in the case of unification. Unification is always an obscure concept. A way of thinking about it is to use topology, more particularly the n -Möbius strip.^{viii} An n -Möbius strip is a tube with n -polygonal cross section twisted by $360/n$ degrees glued end-to-end. When the viewpoint is close to the surface, it is seen to have n surfaces. When the viewpoint is far away so that the whole object is clearly seen, it is seen to have only one surface. Therefore the n -Möbius strip is a model of n -in-one unification. An alternative way of thinking about unification is to use algebra in the concept of mixing. Let $P=M+N$ where M and N are mixtures of M' and N' . Mixing is unitary (conservation of probability) so that $P=M'+N'$. In particle physics, the mixing ratios are probabilistic in nature based on quantum mechanics. Therefore for a very small probability, it is possible for $M=N=M'+N'$. This scenario violates unitarity, but the Heisenberg uncertainty principle allows the violation of conservation for a very short time. This construction meets the criterion of unification aforementioned.

God's eternal nature includes di-unity (two-ness unified into one-ness) as in the hypostatic union of Christ and tri-unity (three-ness unified into one-ness) as in the trinity. The first check of Apostle Paul's natural theology is to see if two-ness and three-ness are manifested in nature. In particle physics, there are three favors of lepton-neutrino doublets (electron, muon and tau). In hadron physics, there are also three generations of quark doublets labeled as up-down, strange-charm and bottom-top. In both particle and hadron physics, there are signs of unifications among the different favors and generations of elementary particles by virtue of mixing. Mixing of elementary particles can be parameterized as linear combination of the same number of more fundamental particles. In hadron physics, mixing of quarks is parameterized by the CKM (Cabibbo-Kobayashi-Maskawa) matrix and in particle physics mixing of neutrinos by the PMNS (Pontecorvo-Maki-Nakagawa-Sakata) matrix. The idea that an elementary particle is made up of more elementary particles sounds like an oxymoron. The origin of the idea was probably motivated by phenomenology. Mixing explains the experimental observations in that different types of particles oscillate among themselves (meaning that one type of particle changes into another). In theology, the three Persons of the trinity (Father, Son and the Holy Spirit) are co-eternal, co-essential and co-equal. If quark and neutrino mixing are reflection of the trinity, then different flavors of neutrinos and different generations of quarks must be co-equal in some ways. This requirement is already partially fulfilled by virtue of being mixed as discussed in the previous paragraph. Deeper understanding of co-equality of flavors and generations may lead to new physics.

Examples of di-unity and tri-unity are also observed outside the domain of physics. In biology, a new classification scheme is recently discovered among several protein families in that a protein can be analyzed into two or three “sectors” (groups of amino acids having distinct biochemical properties) that are not necessarily independent.^{ix} The lack of independence suggests some sort of mixing and is therefore a type of unification. It is also recently discovered that music has a geometrical structure of the 3-möbius band.^x

Christology and trinitarianism took about three hundred years to develop into a set of closed statements. Over the next thousand and seven hundred years, the idea was continuously studied, challenged and re-affirmed; but nothing was added to or subtracted from the original statements in the Nicene Creed since 325 A. D. The 19th century theologian Karl Barth called the doctrine of the trinity the ultimate mystery of the universe (*trinitatis mysterium*). If physics indeed models after theology and if it follows a similar developmental path as the trinitarian theology, then the final theory in physics is likely an ultimate mystery as well. As David Gross has said, if a final theory is not possible, the Standard Model of particle physics is the best that we got. In that case, physics is essentially finished. In the next decade or so, LHC may or may not turn out any new physics. At the moment, neutrino oscillation has already broken the Standard Model. Unfortunately there are so many Beyond-the-Standard Models in the market of ideas that the situation is quickly resembling a landscape as in the case of superstring theory. Judging from the current situation, physics is effectively finished by the way of diminished return. The question of “What is ultimately possible in physics?” cannot be answered from the “inside” within the realm of physics alone. A source of “outside” information is the special revelation contained in the Bible. It is quite possible that the integration of physics and theology is the only way to push back the limit of physics. Having said that, the question of what is ultimately possible in physics is still not answered. In fact it is reasonable to think that the question cannot be answered. The amazing fact is that there are always works to do even when we cannot go any further. Work is not limited by what is possible. It changes as people change. In that sense, physics is never finished as long as we are still thinking and reproducing.

ⁱ John Horgan, The End of Science (London: Abacus, 1998), 32-59.

ⁱⁱ Stanley L. Jaki, Savior of Science (Washington, D.C.: Regnery Gateway, 1988), 121-125.

ⁱⁱⁱ Horgan, 254.

^{iv} Frank Tipler, The Physics of Immortality: Modern Cosmology, God and the Resurrection of the Dead (New York: Doubleday, 1994).

^v David Gross, Marc Henneaux and Alexander Sevrin, The Quantum Structure of Space and Time: Proceedings of the 23rd Solvay Conference on Physics, Brussels, Belgium, 1-3 December 2005 (New Jersey: World Scientific, 2007), 271.

^{vi} <http://www.uctv.tv/search-details.aspx?showID=16805>

^{vii} Mark Kac, Gian-Carlo Rota and Jacob T. Schwartz, Discrete Thoughts: Essays on Mathematics, Science, and Philosophy (Boston: Birkhäuser, 1992), 235-241.

^{viii} Alfred Tang, “Science and Theology: An Integrative Approach”, Th. M. Thesis, Talbot School of Theology, La Mirada, CA (1997).

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- ^{ix} Najeeb Halabi, Olivier Rivoire, Stanislas Leibler and Rama Ranganathan, “Protein Sectors: Evolutionary Unit of Three-Dimensional Structure”, Cell 138 (August 21, 2009), 774-786.
- ^x Rachel Wells Hall, “Geometrical Music Theory”, Science 320 (18 April 2008), 328-329.