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CONTEMPORARY COSMOLOGY IN DIALOGUE WITH CHRISTIANITY

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1. Introduction

Contemporary cosmology is evolving by leaps and bounds, and along with it our growing understanding of the universe and the challenge of its integration into our faith is felt with profound clarity. This dialogue is already taking place both in science and in theology. This paper is an attempt to carry further this dialogical process and to respond to this imperative of our faith and to bring about a dialogue with contemporary cosmology and the theology of creation.

In the first part of this paper, we make an attentive study of the chief features of the dynamics of contemporary cosmology. The second part of the paper strives to reflect on the process of appropriation of the theology of creation by contemporary cosmology. Finally, in the third part, we take up the challenge of the appropriation of cosmology by theology.

2. Growing Understanding of the Universe

We have witnessed an exponential growth in our understanding of our universe. About five hundred years ago the universe was but a small place, and our home Earth was thought to be its centre. But with the rise of modern science in the 16th century our understanding of the universe underwent a quantum leap. We shall try here to survey the length and breadth of contemporary cosmology. To guide our survey, we shall ask the questions 'where' 'how' and 'when', and try to arrive at the immensity, dynamism and evolutionary history of the universe.

2.1. Geographical Models of the Universe

The evolving histories of the geographical models of the universe manifest how humanity grew in its understanding of the sheer size of the universe. The geography of the universe also illumines the place of humanity in the scheme of the universe.

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2.1.1. Geocentric Universe

The geocentric universe comprised of the sun and the five planets (Mercury, Venus, Mars, Jupiter, and Saturn) known at that time. The celestial world was distinguished from the terrestrial realm and was thought to be the abode of gods. Being a divine world it was accepted as the most perfect world and the motion of the planets (understood as gods and goddesses of the Greek Pantheon) was thought to be perfectly circular and uniform. This belief was highly influenced by Plato, Aristotle, and Ptolemy and came to be christened as the circular dogma.[1]

The chief challenge in this closed understanding of the universe was to devise an explanation for the motion of the sun, the moon and the five planets. Aristotle synthesized the efforts of earlier thinkers with his theory of solid spheres.[2] The geo-centric universe was reinforced by Ptolemy. He added the epicycles to account for the irregularities in the motion of the heavenly bodies in the second century A.D.[3]

The geocentric universe was anthropocentric and as such was in harmony with the religious ideas of those days. Enjoying religious legitimacy, it become solidly embedded in the western society and could not be challenged easily. But with the developments in the science and with the use of the telescope the geocentric universe steadily came to be discredited.

2.1.2. The Heliocentric Universe

With the work of Nicolaus Copernicus the hypothesis of Aristarchus[4] was revived 17 centuries after him. Copernicus dependent on a mathematical apriorism opted for the mathematical simplicity of the heliocentric model of the universe in comparison with the geocentric model in his book *Dei Revolutionibus Orbium Coelestium* (1543).[5] The radical nature of this innovation was not only that the earth had to move in order to orbit the sun, but the earth was reduced to one of the planets of the family of the sun, and thus lost its privileged position in the scheme of the universe. Along with the de-centring of the earth, anthropocentrism of humanity lost its firm ground. With the discovery of the moons of the Jupiter, Galileo

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[1]Arthur Koestler, *The Sleep Walker: the History of Man's Changing Vision of the Universe*, London: Penguin Books, 1989, 53-63.

[2]Koestler, *The Sleep Walker*, 61-65.

[3]Koestler, *The Sleep Walker*, 69-72.

[4]Koestler, *The Sleep Walker*, 50-52.

[5]Koestler, *The Sleep Walker*, 121, 127.

provided empirical foundation for a heliocentric view.[6] But being an attack on anthropocentrism, his heliocentrism was vehemently attacked by both scientists as well as religious believers. Some scientists like Tycho Brahe opted for a helio-geocentric model of the universe.[7] The ranging controversy raised many tempers and finally Galileo was condemned by the Catholic Church. The work of Johannes Kepler reinforced the heliocentric model of the universe. He dethroned the circular dogma by scientifically establishing the elliptical orbital motion of the planets around the sun. It was Newtonian Mechanics along with the theory of gravity that provided solid scientific explanatory power to the heliocentric model of the universe.[8]

2.1.3. Infinite Universe

Thomas Digges is said to have looked at the Milky Way through a telescope in 1576, and he saw a multitude of stars as stated in his book, *Prognostication Everlasting* that the universe is infinite with stars in all direction.[9] Giordano Bruno is said to have picked up these ideas when he was in England in the 1580s and almost all the scientists of that age were willing to consider the possibility of an infinite universe.[10] It took a long time for these ideas to be assimilated because the technologies of telescope, astronomical photography and spectroscopy were refined and developed later. From the 1920s onwards, these techniques first led to a better understanding of our place in the geography of the universe, and then to a better understanding of our place in the history of the universe.

In 1750 Durham astronomer Thomas Wright argued in his book, *An Original Theory or New Hypothesis of the Universe*, that the Milky Way was a roughly disc-shaped system with a finite size. He described it as analogous to a grinding wheel of a mill and said that the sun cannot be regarded as the centre of the universe. He further pointed out that the fuzzy paths of light revealed by the telescope known as nebulae lie outside the Milky Way.[11] These were later identified as other galaxies. After the 1920s, we have come to know that the Milky Way was indeed a disc-

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[6]Simon Singh, *Big Bang: The Most Important Discovery of All Time and Why You Need to Know about It*, London: Harper Perennial, 2005, 60-71.

[7]Singh, *Big Bang*, 47-51.

[8]Singh, *Big Bang*, 117-119.

[9]John Gribbin, *In Search of a Multiverse*, London: Allen Lane 2009, 2.

[10]Gribbin, *In Search of a Multiverse*, 2.

[11]Gribbin, *In Search of a Multiverse*, 3.

shaped system containing hundreds of billions of stars each broadly similar to our sun, held together by gravity and orbiting their common centre. The Milky Way is about 100,000 light years across. This means light takes 100,000 years across the disc. But the entire Milky Way is just one island in space which houses hundreds of billions of galaxies as visible in principle to the present-day telescope, although only a few thousand have been systematically studied.[12]

The geography of the universe shows that we belong to an average-sized member of the class known as disc galaxies, the sun is an ordinary star, one among the hundreds of billions of stars and there is nothing special about our earth. We are indeed living in a vast universe. Nor is there anything special about our place in the universe. Astrophysics has put the Copernican Principle that renders the earth insignificant on a firm footing. But the Astro-biologists point out that the earth has the ability to seed and rear life, and the fact that there are several earth-like planets that cannot host life make the earth special in the scheme of the universe.

2.2. Operational Models of the Universe

Our understanding of the working of the universe has also undergone a sea change. One can notice that humanity moved from a universe that depended on capricious gods to a universe operating on regularities that can be discerned through science. We shall make our journey into the saga of the growing understanding of this world picture.

2.2.1. Pre-Mechanistic World Picture

The Pre-Socratic thinkers made an important paradigm shift from a mythological explanation to a material explanation. 'Gods are angry' was a perfect explanation of natural calamities before the Pre-Socratic revolution. The Pre-Socratic thinkers not only materialized but also rationalized nature. They thought that nature behaved rationally and one can discern the regularity behind its behaviour. That is why they can be regarded as the big bang of science as they sowed the seeds of scientific explanation. The Pythagorean mathematized and the Atomist atomized nature.

We can notice a movement from the Mythos to the Nomos[13] among them. Later thinkers like Aristotle emphasized a telenomy. It meant telos operated as a galvanizing cause, and became an overriding cause that

[12]Gribbin, *In Search of a Multiverse*, 3.

[13]Robin Waterfield, trans., *The First Philosophers: The Pre-Socratics and the Sophists*, Great Clarendon Street: Oxford University Press, 200, xi-xv.

could explain everything in the universe. This understanding of the universe was based on the meaning and significance of things rather than prediction and control. That is why the medieval scientists looked for a purpose underlying various natural phenomena and considered questions relating to God, the humans soul, and ethics.

2.2.2. Clockwork Universe

From 1500 to 1700 there came a paradigm shift in the understanding of the universe. This development was brought about by the revolutionary changes in Physics and Astronomy culminating in the work of Copernicus, Galileo, and Newton. The revolutionary change was based on the new method of inquiry (Novum Organon) advocated by Francis Bacon, that included a mathematical description of nature and analytical method of reasoning conceived by Rene Descartes that was based on a certainty that was mathematical in its very nature.[14] Galileo appears to be the first to combine scientific experimentation with the use of mathematical language to formulate the laws of nature. In order to mathematize nature Galileo postulated the quantifiable properties as the essential properties of material bodies, and taught that the great book of nature was written by God in the alphabet of mathematics. Descartes also believed in the mathematical language of nature, and led him to apply mathematical relation to geometrical figures, and correlate algebra and geometry. In doing so he founded a new branch of mathematics, known today as analytic geometry. Descartes also thought of the material universe as a machine. He believed that nature worked according to mechanical laws, and everything in the material world could be explained in terms of arrangements and movements of its parts.[15] This view of nature as a machine governed by exact mathematical laws became a framework for the scientific enterprise. Newtonian physics became a crowning achievement of this framework. In Newtonian mechanics all physical phenomena are reduced to the motion of material particles caused by forces acting between them. The effect of these forces could mathematically be described by Newton's equation. These were considered fixed laws according to which material objects moved. Newton believed that God in the beginning created the material particles, the forces between them and the fundamental laws of motion. Thus, the universe was a huge cosmic machine that worked like a clock,

[14]Fritjof Capra, *The Turning Point*, London: Flamingo, 1983, 37-42.
[15]Capra, *The Turning Point*, 43-49.

and God came to be seen as the Chap who wound the clock.[16] Hence, everything in the universe is determinate, and by the same token predictable and accurately discernible through science. The theory of heat and Maxwell's electromagnetic theory carried further the baton of the mechanistic and deterministic world picture in the nineteenth century.[17]

2.2.3. Dynamic Universe

The developments in the twentieth century physics derailed the static clockwork Newtonian world picture. The Special Theory of Einstein dealt a death blow to the Newtonian concept of absolute time and space as it showed that time and space make the fourth dimension, spacetime. Time is elastic and hence can be shrunk and stretched by motion. To achieve an appreciable time warp speeds of many thousands of miles per second are necessary. Space is also elastic. When time is stretched, space is shrunk. We cannot notice these effects because they are too small at ordinary speeds, but they can be easily measured by sensitive instruments.[18] Paul Davies states that 'the mutual distortion of space and time can be regarded as a conversion of space (which shrinks) into time (which stretches).'[19] A second of time, however, is worth an awful lot of space – about 186,000 miles per second. Einstein went on to generalize his theory, and led it to embrace the effects of gravity. The resulting General Theory of Relativity appropriates gravity, not as a force but a distortion of the spacetime geometry. The stronger the gravity the more pronounced is the time warp. Thus, Einstein united space, time, matter, and motion which are the fundamental concepts on which the entire edifice of Newton was built.[20] The Quantum theory further dented the Newtonian static model of the universe as the solid atomic particles of Newtonian mechanics were broken into sub-atomic particles. The principle of uncertainty that reigns in the weird quantum world demonstrates that the static and deterministic world of Newton was several light years away at the sub-atomic level.[21] The theory of Relativity and the Quantum theory deal with two different dimensions of the universe. Hence, the need is felt to bring them together so that we can have a complete picture of the universe. Unfortunately we have not yet succeeded in producing a unified theory which can be regarded as a

[16]Capra, *The Turning Point*, 49-55.

[17]Capra, *The Turning Point*, 57.

[18]Paul Davies, *God and the New Physics*, New York: Simon Schuster, 1983, 120-121.

[19]Davies, *God and the New Physics*, 121.

[20]Davies, *God and the New Physics*, 122.

[21]Davies, *God and the New Physics*, 100-118.

theory of everything (TOE). Physicists Ilya Prigogine and Isabelle Stengers teach that chaos or disorder can organize into a higher order. This has led some scientists to propose that we are living in a self-organizing universe.[22] The holistic picture that is emerging from the twentieth century physics shows that we are part of a dynamic, interrelated, indeterminate (creative) universe.

2.3. The Historical Models of the Universe

By historical models of the universe we mean to look at the life history of the universe. Here, we trace the evolutionary history of the universe. The evolutionary history of our universe presents that our universe is 13.7 billion years old. Science today is able to predict its possible fate. But due to our inability to accurately discern the amount of dark matter in the universe we cannot accurately predict the fate of the universe.

2.3.1. The Big Bang Universe

We inhabit a dynamic universe. Everything in the universe has its life cycle. Nothing is eternal. The universe seems to have had a definite beginning in a moment of time. By March 1919 British astronomer Arthur Eddington had proved the orthodoxy of the General Relativity of Einstein. Einstein had already attempted to extend his General Theory of Relativity to the entire universe. To achieve this purpose, he made an assumption that he called the cosmological principle. The principle assumes that the universe is isotropic (which means that the universe looks the same from all directions) and is homogenous (which means to say that the universe looks the same wherever you happen to be. This means that our location on the earth is not unique or privileged). But the application of this theory and its gravity formula to the universe disappointed Einstein as it suggested that the universe is ominously unstable as his formula of gravity showed that every object in the universe was pulled towards every other on the cosmic scale. This predicted a crunch which meant that the universe was destined to destroy itself. Newton too was troubled by a collapsing universe but he overcame it by suggesting that the universe was symmetric, and hence every object would be pulled equally in all directions and therefore the overall cancellation of the forces and hence no collapse. But he soon realized that this equilibrium is only theoretically possible but in practice a slightest change could end in a catastrophe. For instance, a moving comet through the solar system may momentarily

[22]Ilya Prigogine and Isabelle Stengers, *Order Out of* Chaos, New York: Bantham Books, 1984, 12.

increase the mass density resulting in a collapse. Hence, Newton suggested that God intervened from time to time to keep the celestial equilibrium. Einstein did not want to leave it to God to save the collapsing universe like Newton, and introduced a cosmological constant in order to maintain the eternal and static universe which was in accordance to the scientific orthodoxy of his time. The cosmological constant gave rise to a new repulsive force throughout the universe which effectively worked against the gravitational force in a collapsing universe. In some way Einstein seems to have ended up like Ptolemy who introduced his epicycles to save a static geocentric universe.[23]

Alexander Friedman, a Russian mathematician had the audacity to challenge and defy the role of the cosmological constant, and stated that Einstein's theory without a cosmological constant gave rise to a dynamic and evolving universe. Friedman associated the dynamism with the universe that might have been kick-started with and initial expansion so it has an impetus to fight against the pull of gravity.[24] This model of an expanding and evolving universe was very radical and novel in those days and was unacceptable till it was scientifically established by the American scientist Edwin Hubble in 1929. Before that in 1927, George Lemaitre, a Belgian diocesan priest had rediscovered the dynamic evolutionary model of the universe. Theorizing on the physical history of the universe Lemaitre ran the clock backward and arrived at an apparent start of the universe. He taught that the universe began as a primeval atom that exploded and generated all matter in the universe which then evolves over time to become the universe as we know it today. Einstein rejected this proposal in the same way that he had Friedman's theory. It was the absence of evidence that allowed the scientific establishment to be swayed by prejudice, favouring Einstein's static model of the universe against Friedman and Lemaitre expanding the Big Bang Model.[25]

It was in 1929 that Edwin Hubble who earlier in 1924 had shown that our galaxy was not the only one in the universe, provided the evidence through his discovery of the running away galaxies, and so the idea of a static eternal universe came under a tremendous challenge in science. He showed that light from the distant galaxies was not even shifted to the red end of the spectrum and catalogued that the speed at which a galaxy was

[23]Singh, *Big Bang*, 144-148.
[24]Singh, *Big Bang*, 150-156.
[25]Singh, *Big Bang*, 156-161.

moving away was directly proportional to its distance from us.[26] The godfather of the Big Bang theory and its die-hard opponent, the famous British astronomer Sir Fred Hoyle along with Physicists, Hermann Bondi and Thomas Gold attempted to resurrect the static model of the universe with the steady state universe. The Steady State Theory taught that the universe had no beginning, but expands because of the continuous and spontaneous creation of hydrogen atoms.[27] But the Steady State Theory was dealt a death blow with the accidental discovery of the cosmic background radiation predicted by George Gamow[28] in 1965 by Arno Penzias and Robert Wilson.[29] This discovery was reconfirmed by the NASA scientists in 1992.[30] The standard model of Particle Physics allowed scientists to reconstruct the Big Bang scenario. The Inflation Theory that claims that the universe expanded enormously, 10^{50} between 10^{-35} seconds to 10^{-33} seconds, after singularity, is widely accepted as integral to the Big Bang theory.

2.3.2. Beyond Big Bang

The Big Bang theory successfully explains many fundamental aspects of our universe such as the isotropic background radiation, the relative abundance of helium (25%) and other light elements and the velocities of the galaxies. Although the Big Bang model of the universe supports the idea that the universe had an edge in the past, a initial moment of infinite density and temperature which is called singularity, it is applicable to the universe only after the temperature and density have dropped sufficiently. Hence, it is appropriate to speak of this moment as slightly later than the singularity or T=0. Hence, the Big Bang theory successfully describes the subsequent evolution of the universe rather than its origination. The laws of physics as known to us today break down at about 10^{-43} seconds (Planck Time). Before this moment, quantum effects on gravity are not well known. Planck time lies between the singularity and the beginning of our explanations concerning the early universe. Hence, we enter a speculative domain and we have many competing proposals that attempt to describe the scenario before the Planck time.[31]

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[26]Singh, *Big Bang*, 214-229, 249-261.

[27]Singh, *Big Bang*, 337-353.

[28]Singh, *Big Bang*, 306- 336.

[29]Singh, *Big Bang*, 422-438.

[30]Singh, *Big Bang*, 442- 443.

[31]Willem B. Drees, *Beyond the Big Bang: Quantum Cosmologies and God*, La Salle: Open Court, 1993, 41-44.

In this context, scientists depend on the sophistication of Particle Physics and Quantum Theory. As a result most of the proposals are more like visions which guide subsequent research. Some propose that singularity can be seen as conception or birth, being the beginning of time from the perspective of the child, but the same can be viewed as an event as seen by the mother. This analogy can particularly illumine some of the wave-fluctuation models that try to speculate on the origin of the universe. Edward Tryon presents a Big Bang model in which the 'universe is a fluctuation of the vacuum' of quantum field theory. He points that the universe may simply be a fluctuation of the vacuum, the vacuum of a larger space in which our Universe is embedded. Thus he patterns the characteristics of the universe analogically to the ghost-like properties of a quantum system. By 1982 Alexander Vilkin developed and mathematically systematized the vacuum fluctuation.[32]

Andrej Linde, one of the cosmologists who proposed that the universe underwent a rapid period of expansion which is called inflation, supports a kind of chaotic cosmology. His version argues for an eternally existing, self-producing universe. This proposal like other inflationary model is like a ball on a slope: it has kinetic energy which reflects its movement and potential energy, as it can roll further down the slope and thereby gain kinetic energy. The conditions for inflation might have been in some regions while not or only later in other domains. Thus the regions of inflation form what he refers to as bubbles or mini-universe. Hence, the universe as such would not be homogenous but a cluster of bubbles, mini-universes, attached to each other. Linde teaches that bubble formation will continue unceasingly reproducing the universe and making it immortal.[33] Linde's model attempts to account for the spatial expansion in time while fails to consider the evolution of time. The Hartle-Hawking proposal of 1983 takes up the issue of time. In his book, *A Brief History of Time*, published in 1988, Hawking popularized a new theory, based on quantum gravity, that taught that the universe is finite but without time or space boundaries, that is to say without beginning or end. Hawking had presented this 'no-boundary condition' proposal in 1981 in a conference at the Vatican. The quantum theory of gravity puts time and space on an equal theoretical footing, allowing space-time to be finite in extent and yet have no singularities to form a boundary or edge. Thus Hawking proposes

[32]Mark William Worthing, *God, Creation and Contemporary* Physics, Minneapolis: Fortress Press, 1996, 98-100.

[33]Drees, *Beyond the Big Bang*, 48-52.

that time near the Singularity is very unlike our ordinary time. This means that our interpretation of time breaks down. Hawking points out the similarity between his view and the one of St. Augustine who introduced into the Christian tradition the notion of time being part of the created order. St. Augustine probably understood the beginning of time with creation as an event outside the scope of our natural knowledge. Hawking on the other hand keeps the understanding of the beginning of time within the reach of humanity and uses quantum physics to indicate that spacetime and matter pops up at t=0.[34]

2.3.3. The Multiverse Hypothesis

Quantum theories are very successful but their interpretation is still subject to discussion. The Copenhagen Interpretation teaches that it is meaningless to ask what atoms, electrons, and other quantum entities are doing when we are not looking at them. Moreover we can never be certain what the outcome of a quantum experiment will be. All that we can do is to calculate the probability that a particular experiment will come up with a particular result. Some outcomes are more likely, others are less likely, and some others are impossible. When quantum entities are not observed they dissolve into blur (mixture) that is called wave function representing the various probabilities. This mixture is christened as superposition of the states. When a measurement is made, the act of measuring leads the quantum entity to choose one of the states, in line with various probabilities and the wave function collapses. But as soon as the measurement is made the quantum entity returns to a new superposition state. Some claim that the supposition of the Copenhagen Interpretation merely reflects our ignorance (hidden variables). This tension between many possibilities and the (apparently) one actuality was later taken to another startling conclusion by the American physicist Huge Everett. He taught that all quantum states of quantum entity are equally real. This means that from his viewpoint all elements of a superposition are actual. None are more real than the rest. He successfully quantizes a closed system like the universe of general relativity into many worlds. Bryce DeWitt and Neill Graham brought the many worlds interpretation of Quantum Mechanics to the knowledge of the Scientific Community.[35]

David Deutsch takes the Many Worlds Interpretation of Everett at face value but with a difference. Everett taught that the universe would

[34]Drees, *Beyond the Big Bang*, 52-57.
[35]Gribbin, *In Search of a Multiverse*, 19-35.

split whenever it is faced with a choice of quantum possibilities, giving rise to an image of a many-branched tree, and the unfortunate hidden implication that there might be a main trunk from where the branches are stemming. But Deutsch prefers a vast array of which all start out same and have identical histories up to a point where the quantum choice has been made. It is like having an infinite library full of copies that all start out in the same way on page one, but in which the story in each book deviates more and more from the versions in other books, the further we read into the book. This position is an improvement on Everett as his position could be described with a single book that split repeatedly into more and more different books as we try to read it.[36]

Although it is quantum physics that gives a solid scientific basis to the idea of a Multiverse, it is the existence of an array of cosmic coincidences that point to the need for such an Idea in the first place. In 1989 Martin Rees and John Gribbin presented anthropic cosmology in their book *Cosmic Coincidences*. Martin Rees, a British astronomer, developed the same theme in his book *Just Six Numbers*, where he selects just six cosmic coincidences out of many more to drive home how the hypothesis of a Multiverse becomes scientifically orthodox. The coincidences are considered as essential for the universe to be able to bring about and care for intelligent life. Earlier Brandon Carter in 1973 had pointed out that the presence of humanity may not be central to the universe, yet it is in some sense privileged. We can also trace some kind of anthropic reasoning in Fred Hoyle. Martin Rees teaches that our universe and the law governing it had to be fine tuned to allow our emergence. The stars had to be formed; the nuclear furnace that keeps them burning had to transmute pristine hydrogen into carbon dioxide, oxygen, and irons; a stable environment, and a vast span of space and time, were prerequisites for the complexities of life on earth. Martin Rees sees the apparent 'fine tuning' as indicative of the fact that our universe could be just one member of a countless ensemble of other universes where fine tunings are different. The best analogy is lottery where the six numbers have to be chosen to have a chance of a friendly universe for intelligent life. Our universe happens to be that winning lottery and the other non-winning numbers belong to other universes of the ensemble. It means that we are just lucky.[37]

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[36]Gribbin, *In Search of a Multiverse*, 62-66.
[37]Gribbin, *In Search of a Multiverse*, 36-61.

There is another way of understanding our physical world. Instead of regarding the fundamental entities such as electrons as tiny spheres or mathematical points it thinks of them as loops of vibrating stuff, prosaically called 'strings'. From the mid 1980s there was a growing appeal of this string theory and it was seen as one that will unify the general theory of relativity and quantum theory and lead humanity to develop a theory of everything. Every variation of the string theory works only if the strings occupy more than four dimensions (three dimensions of space and one dimension of time). The theory works with complex mathematics and eleven dimensions (ten dimensions of space and one dimension of time). In the 1990s, there were about five versions of string theory that were considered as competing candidates for the theory of everything. Each of them requires six compactified (curved up into space of very small size or curled to a scale that we cannot see them) dimensions plus the usual four dimensions. There was the sixth theory known as the Super Gravity which required eleven dimensions. Scientists hoped that one of the six would turn out to be better than the rest. But in 1995 Edward Witten, at Princeton, showed that they were all equally good because they were all part of the same thing. He showed that there are ways to transform each of the other implying that they are different facets of some underlying theory, the true theory of everything.[38]

The fact that all the models were different aspects of a single underlying theory meant that the string models like supergravity, actually required ten dimensions of space plus one of time. But time, the eleventh dimension, will not have to be compactified. It can be very big but will lie in the space dimension at right angles to all the other familiar dimensions of space. If our whole universe were represented as a flat sheet of two-dimensional paper lying on our table, this extra-dimension would be at right angles to the surface of the paper, extending upwards in the third dimension. All this brought about a tremendous change in our understanding of the String Theory. Instead of thinking of the fundamental entities as vibrating strings we are now thinking of them as vibrating sheets or membranes, like the skin of a drum. It is expressed in mathematical language where a point is o-brane, a line or a string is 1-brane and the sheet is 3-brane. There are higher dimensions that are expressed as 4-branes, 5-branes or generically p-branes where p can be any number from zero to nine. Witten called the whole ensemble of ideas an

[38]Gribbin, *In Search of a Multiverse*, 144-151.

M-Theory. No one seems to know what the 'M' stands for. It may stand for 'master,' 'mystery' or 'miracle.' The M-theory has eleven dimensions. But this extra space dimensions cannot be curled in the same way. The mathematics of the theory restricts the manner in which dimensions of the internal space can be curled. M-theory teaches that the shape of the curled internal space determines the values of physical constant, such as the charge of the electron and the nature of interaction between the elementary particles. This means that the shape of curled internal space determines the laws of nature that is the laws of the four forces of nature are determined by the more fundamental laws which are studied by M-theory. Hence, M-theory allows different universes with different apparent laws depending on how the internal space is curled. M-theory allows as many as 10^{500} ways of curling the internal space which means it allows 10^{500} different universes, each with its own laws.[39]

As recently as September 2010, Stephen Hawking and Leonard Mlodinov in their book *The Grand Design* emphatically present the hypothesis of the Multiverse. Along with Edward Witten, Hawking believes that our search for the ultimate theory of everything is over. What we need to do is to understand the mathematical implications of M-Theory. But M-theory is not yet a proper scientific theory and is not scientifically fully tested. At the moment it is just a compelling and beautiful mathematical construct and only one of the numbers of candidates for theory of everything.

3. Theological Appropriation by Contemporary Cosmology

Contemporary cosmology provides great opportunities as well as challenges for a theological appropriation of modern science. We shall first elaborate some of the contemporary attempts to elaborate the theistic implications of contemporary cosmology, and propose that we need a prophetic or critical appropriation of the findings of contemporary cosmology.

3.1. Contemporary Scientists and the Idea of Creation

One can notice that a debate on the theistic implications of the Big Bang. One can trace active appreciation, passive indifference, as well as straight forward rejection among contemporary scientists. Scientists like Robert Jastrow of NASA's Goddart Institute believes that there is a remarkable concurrence between Scripture and Science. He drives home his point

[39]Gribbin, *In Search of a Multiverse*, 152-172.

when he says, "Now we see how the astronomical evidence leads to the biblical view of the origination of the world. The details differ but the essential elements in the astronomical and the biblical accounts of Genesis are the same: the chain of events leading to men commenced suddenly and sharply at a definite moment of time, in a flash of light and energy."[40]

At the same time, reputed scientists like Steven Weinberg, Stephen Hawking and others opt for an atheistic interpretation of contemporary cosmology. While being respectful of their atheistic views, we can see that they act like whistle blowers and call us for a prophetic appreciation of implications of contemporary cosmology to our faith in the creation of the cosmos. As the Big Bang is a theory of the subsequent development of the cosmos (from Planck's time) and not it absolute origination, any attempt of its hurried appropriation into theology would put the cart before the horse. We can notice a similar reasoning in the caution given by George Lemaitre to Pope Pius XII who was quick to welcome the theological implications of Big Bang.

In view of the same, we can find an abandoning of the temporal beginnings or origination in favour of ontological origin among some of the scientists today. This detemporalization of the understanding of the doctrine of creation in line with absolute dependence or sustaining relation of Friedrich Schleiermacher[41] is popular among contemporary scientist theologians like John Plokinghorne who clearly states that 'creation is concerned with ontological origination, not temporal beginning.' This ontological origination correctly leads to an appropriation of divine immanence as creation. One can find this position in Arthur Peacocke, a scientist theologian from England who seems to end in panentheism. One might look at these above attempts at 'fine tuning' of the doctrine of creation to suit or adjust to some of the implications of contemporary cosmology that try to avoid a cosmic beginning.

At the same time 'fine tuning' of scientific positions to suit one's theological position can also be observed among some of the scientists. Thus for instance, Fred Hoyle worked hard to discredit the Big Bang theory only because it seemed to resemble the creation account of Genesis. The same appears to be the motivation of Stephen Hawking and many others who seem to opt for alternative cosmological theories not involving a cosmic beginning.

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[40]Robert Jastrow, *God and the Astronomers*, New York: W.W. Norton, 1978, 14.

[41]Friendrich E. D. Schleiermacher, *The Christian Faith*, vol. I, trans. Richard N. Niebuhr, New York: Harper and Row, 1963, 148-152.

3.2. Assimilation of Theology in Science

The astronomer Jatstrow seems to suggest that with scientific discoveries which led to the Big Bang theory was like climbing the same peak as theology. Apparently this feeling is reinforced mainly by the quantum cosmologies that seem to speak of creation out of nothing. The transformation of matter out of pure energy that resulted from the matter/anti-matter imbalance in the Big Bang is seen as creation out of nothing by many scientists. The end result of this annihilation was production of photons (the remnant which is still detectable as the universal background radiation discovered by Arno Penzias and Robert Wilson in 1965). The remaining matter particles were left to develop into protons, neutrons and eventually into atoms and galaxies and planets. Hawking holds that in quantum theory, particles can be created out of energy in the form of particle and anti-particle pairs. But the question is: From where did the energy come? Hawking suggests that the positive and negative energy balance means the total energy of the universe is zero. If from this mathematical zero energy matter and anti-matter particles were created yet this is hardly what we mean by *Creatio ex Nihilo*.[42]

The linguistic blur achieved through the borrowing of theological terminology into cosmology has allowed scientists to understand the early universe but at a cost. The meaning of the theological term, 'creation out of nothing' changes because in quantum physics 'nothing' does not mean 'no thing'. Hence, the reintroduction of the notion that is burnt in the furnace of science into theology requires critical examination as there can be a loss of its original meaning. Hence, contrary to the claim of some scientists modern science has not yet discovered creation out of nothing as the array of laws, principles and quantum fluctuations requires explanation. But this does not mean that contemporary cosmology has nothing to offer to the doctrine of 'creation out of nothing'. This means that the classical doctrine of creation out of nothing has become scientifically intelligible. But the scientific model of creation out of nothing has been used as arguments against the existence of God. It is precisely such a cosmology that prompted Hawking to ask the now famous question 'What place, then, for a creator. It seems to bring home the proverbial Pierre-Simon de Laplace's response to Emperor Napoleon's query about the absence of God in his system of the world: 'I have no need of that hypothesis'!?

[42]Worthing, *God, Creation and Contemporary Physics*, 95-97.

3.3. Science Becoming Theology

One can find a kind of usurpation of the role of theology in the work of some scientists. The physicist Tipler, for instance, regards that physics is too considered as theology. He thinks that physics and theology can reach similar conclusions. This view somehow challenges the interpretive authority of theology. Theology had the privilege of providing the interpretive matrix in the context of science and theology dialogue. But this reduction of theology to physics somehow annihilates the autonomy of theology and permits its unscrupulous absorption into science.

John Barrow and Tipler, in their book, *The Anthropic Cosmological Principle*, drive home the point that the values of a large number of fundamental cosmic constants lie within an extremely narrow range – the only range that would allow for the emergence of life. The observation of the apriori improbability that all the fundamental constants may line up to give us a universe with intelligent life is called the weak anthropic principle. The strong anthropic principle advocated by Barrow and Tipler teaches that our presence in the universe constrains the evolutionary past of the universe. Thus, using the interpretation of quantum theory such as 'quantum observer-created reality', our presence in the universe is thought to be essential for its evolution.[43] In his book, *The Physics of Immortality*, he pursues an ambitious goal that strives to extrapolate the anthropic principle to the final days of the cosmos, and arrives at an eschatology that he interprets as what Christians mean by the resurrection of the dead in the final singularity (Big Crunch).[44] Tripler presents this moment as the omega point, resurrection or fuller manifestation of God.[45]

This project of the reduction of theology to physics has not won much acceptance in the scientific community. Although his Future God Hypothesis sounds radical, it has very few takers. One does science first and then allows theologians to theologize based on its empirical findings. This innovation of putting the cart before the horse at best amounts to a free flight of imagination and is presumably against the very spirit of science.

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[43]John Barrow and Frank Tipler, *The Anthropic Cosmological Principle*, New York: Oxford University Press, 1986.

[44]Frank Tipler, *The Physics of Immortality: Modern Cosmology, God and the Resurrection of the Dead*, New York: Doubleday, 1994.

[45]Frank Tipler, "The Omega Point Theory: A Model of an Evolving God" in Robert. J. Russell, William R. Stoeger, and George V. Coyne, *Physics, Philosophy and Theology a Common Quest for Understanding*, Vatican: Vatican Observatory, 1988, 313-331.

4.1. Prophetic Acceptance of Contemporary Cosmology

4.1.1. Building Cognitive Consonance

Some scientists hold the religious neutrality of contemporary cosmology. Ian Barbour, a scientist theologian, calls us to be cautious about relating t=0 to God. He teaches that it sounds too much like the God of the Gaps. But there is no doubt that cosmological models are relevant to theology. Ted Peter, a contemporary theologian, evolved in the science faith dialogue says that we must work for cognitive consonance through a fruitful conversation between Science and Christianity. Hence, the principle of caution calls for a critical and prophetic appropriation of contemporary cosmology by our theology. This means that we have to look for cognitive consonance between the doctrine of creation out of nothing and the findings of science. It is not that science will add anything new to the revealed truth about creation but it will illumine it and allow it to shine and assist us to understand its deeper nuances. In this context, we must understand that the familiar terms like 'the beginning of the universe,' 'creation out of nothing,' or simply 'creation,' 'omega point,' 'resurrection,' 'immortality,' and many others are not theory neutral. They are indeed theory laden and therefore provide us with the opportunities to build a consonance by a critical examination of their shifting meaning and along with the continuities of meaning that they bring into our conversation of science and the doctrine of creation. This sensitivity to continuities and discontinuities can be illuminating for both Science and Christianity. Although there are claims about the universality of the belief in creation yet we do not regard Christian doctrine of creation as simply an instance of a single general theory somehow shared by the entire humanity. There is certainly uniqueness in the Christian doctrine of creation and this uniqueness has to be attentively discerned in an active dialogue with science. The trinitarian and salvific foundation, along with *creatio ex nihilo* and *creatio continua* forms the crux of the doctrine of creation. Hence, we need to be sensitive to the epistemologies of ignorance that are operating in our theologizing and practice of science.

4.1.2. Learning from the Epistemologies of Ignorance

It is important to be sensitive to what is known as the epistemology of ignorance.[46] When ignorance operates as knowledge it is disastrous for any society. Today we have a spring time for the research on epistemologies of ignorance especially in feminist science studies, and critical race theories. These studies look at the disparity between knowledge claims of the

[46]Shannon Sullivan and Nancy Tuana, *Race and Epistemologies of Ignorance*, Albany: State University of New York Press, 2007.

dominant groups and the relatively scientific and social realities. These studies expose the condition of production and operation of knowledge claims that are often grounded in ignorance and by that very token self-deluding. Such self deluding knowledge claims also gives birth to insider/outsider, centre/margin power relations to privilege some and disadvantage others when faced with opaque minority ways of living and being human. These epistemologies look for a remediation of these power relations through their work.

It is obvious that epistemologies of ignorance have been part of Science-Christianity relationship down the ages. This dynamic dialogue can be seen especially in its phases of conflict as moved by the politics of epistemologies of ignorance. One might think that it was an epistemology of ignorance that led us to condemn Galileo and also to question Darwinism. In this context it would be appropriate to clarify that when we use the term epistemologies of ignorance we use it to mean a condition where ignorance begins to take the place of knowledge. Hence, in our dialogue with contemporary cosmology we need to be critical enough to separate true science that is based on empirical evidence and speculation that is striving to acquire the status of knowledge. No thought that scientific hypothesis or speculation like any other knowledge quest is based on an epistemology of ignorance. That is, we depend on the background that shapes as a supporting outline and framework that we are ignorant about (cannot explicitly know). But what the epistemologies of ignorance that we have tried to evoke here is a narrow concept that considers ignorance as knowledge. One can also notice a similar operation of epistemologies of ignorance among creationists who assign a value of science to their biblical literalism.

4.1.3. Revelation as Axis of Appropriation of Contemporary Cosmology

Contemporary cosmology has changed the worldview of humanity. Unfortunately theologians are slow to comprehend the depth of the transformation it has unleashed. But a reception of contemporary cosmology has to be guided by Revelation. The normativity of Revelation is the guiding principle for any osmosis of Science with Catholicism. Hence, the compatibility of science with the deposit of faith becomes the hermeneutical meeting ground of science and catholic faith.

In this context the role of the magisterium becomes important. It is for the magisterium to indicate which presuppositions, views and interpretations of science are not compatible with the revealed truth. The

discernment of the magisterium limits only to those cases that are not compatible with the revealed truths leaving ample space for us to explore possibilities to bring about a fruitful integration of science with our catholic faith. The Church has achieved a great appropriation of Aristotelian science through the work of the angelic doctor St. Thomas Aquinas. In the light of this new development in science it is for us to work for a new appropriation of the findings of science by our theology.

4.2. Theologizing in the Light of Contemporary Cosmology

4.2.1. Natural Theology and Contemporary Cosmology

Most cultures accept that Nature mirrors the divine, and that humans have a natural ability to decode it. This is perhaps the reason why it is held that belief in creation is universal. This means that humanity all over the world throughout history has held some kind of belief about the origin and nature of the universe. This suggests that humanity believed in a meaningful universe, and God was somehow a central coordinate of the meaning of the universe. Some people even believed that humans are microcosms and as such are capable of reflecting the divine in their nature and life.

The catholic faith accepts this ability of human beings to contemplate the truth on the wings of reason as a divine gift. It is through this *diakonia of truth* that we join humanity's struggle to arrive at truth. Along with philosophy, science reflects this human solidarity in its quest for truth. Hence our *diakonia of truth* leads us to appreciate and promote science as it has the power to illumine the truth about us, our Cosmos, and our God.

Contemporary cosmology also reveals the faces of God, Cosmos and Humanity. The evolutionary dynamism and the interrelatedness of the Cosmos makes a paradigm shift and de-centres both a spectator God and humanity, and manifests the dynamically involving God of love and participatory humanity in the evolutionary drama of the universe.

4.2.2. Response of Faith to Contemporary Cosmology

Christian doctrine of creation is a response of faith. It is not merely an intellectual or even religious position. It has a creedal or confessional form. An attentive scrutiny of this creedal form manifests that it is not something self-evident or a discovery of disinterested reason. 'I believe in God the Father, maker of Heaven and Earth' is the same thing as saying 'I know intuitively' or 'reason shows me that.' This means that the doctrine of creation developed as a response of faith. It was born in dialogue with the biblical faith, in dialogue with the creation claims of its times. The Greeks believed that matter was eternal and inferior to spirit, the Gnostics

and the Manichean beliefs considered matter as evil. In contrast to this belief claims, Christian faith in creation became an intellectual breakthrough as it taught that matter is intended and created by God and by that very token good! The creative act was not thought to be arbitrary but was regarded as purposive since it flowed not just from the will but the love of God. We can find here both the Trinitarian as well as salvific foundations of creation. Moreover, it achieves another remarkable breakthrough, though the doctrine of creation out of nothing as it successfully establishes a close relation with God, and not dissolves into God as in the case of pantheism, that is, it achieves a perfect harmony between divine immanence and transcendence. Hence it becomes an imperative for our faith to seek an integration of our creedal faith with the teachings of contemporary science. The Big Bang theory that has been scientifically established by the mainstream scientific community is compatible with the doctrine of creation. Even the other speculative proposals that have not become scientifically established do not rule out a theistic interpretation. Even the most atheistic among them can be deconstructed and rendered open to a theistic interpretation as the matrix from where structures of space time and matter emerged to form a universe or multiverse as some would want us to accept, is open to a theistic interpretation. Hence, these speculative positions are not to be seen as threats to the doctrine of creation.

5. Conclusion

Our pilgrimage into contemporary cosmology demonstrates that humanity has indeed reached a high level in its understanding of the universe. This arrival on the peak of cosmology is regarded as coming on the same peak of theology by scientists like Jastrow. We have tried to maintain a critical distance from this over-enthusiastic approach and propose a rather discerning reception of science that is based on the dual principle that separates science from mere scientific speculation, and one that accepts the primacy of revelation.