PONTIFICIA UNIVERSITAS GREGORIANA
Facultas Theologiæ

Theologiæ Creationis et Scientiæ Modernæ Convenientia in Pont. Max. Benedicti XVI Cogitatione

Thesis
pro
Sacræ Theologiæ Licentia
in
Theologia Fundamentale

Discipulus: Reverendus Dominus Ioseph R. Laracy, S.M. (Ingeniaria), S.T.B.
Pontificium Collegium Civitatum Fœderatarum Americæ Septemtrionalis
Matriculum: 159118

Moderator: Reverendus Dominus Paulus Haffner, M.A. (Physica), S.T.D.

Romæ
Anno Domini MMXIV

DEDICATION

This thesis is dedicated to
His Holiness Benedict XVI, Supreme Pontiff Emeritus,
who has deeply inspired me both as a priest of Jesus Christ and as a theologian.

May God continue to bless him abundantly.

ACKNOWLEDGMENTS

I am deeply grateful for the knowledge, wisdom, and encouragement that I have received from my thesis advisor, the Reverend Paul Haffner, S.T.D.

I would also like to thank my Archdiocesan mentor, the Reverend Douglas Milewski, S.T.D., and my mentor at the Pontifical North American College, the Reverend Robert Blyman, M.D., who have both been a real support in my first year of priesthood, in particular in this endeavor.

The reviews offered by the Reverend Mr. Jonathan Ficara, Scott Valentyn, and Matthew Laracy have been of great assistance in refining this work.

Finally, my parents, Paul and Catherine Laracy, must be acknowledged for their extraordinary love and care, particularly in these last five years in the Eternal City.

Reverend Joseph R. Laracy
19 March 2014
Solemnity of St. Joseph

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I. INTRODUCTION

A. What is Creation?

> In the beginning God *created* the heavens and the earth. The earth was without form and void, and darkness was upon the face of the deep; and the Spirit of God was moving over the face of the waters.[1]

In the twenty-first century, if one were to mention the word "creation" in a lecture hall at a secular, and perhaps even at a Catholic university, the hearers would assign a variety of connotations to the term. Interestingly, both Catholic theologians and atheist critical theorists would immediately associate this word with the beginning of the Book of Genesis. However, Christians and atheists would make an essential distinction in understanding the act of creation. The Jewish people who first received the Word of God and the inspired teaching of the Lord on creation, as well as Christians of the first century A.D., clearly understood that creation referred to a *meta*physical concept – literally *beyond* physics. Conversely, the contemporary non-believer would likely place the term in the realm of the physical.

This misunderstanding of the character of creation was sadly evidenced in a recent book by one of the most prominent theoretical physicists of our time, Stephen Hawking. In his 2010 book, *The Grand Design*, Professor Hawking stated:

> Because there is a law such as gravity, the universe can and will *create* itself from nothing…Spontaneous creation is the reason there is something rather than nothing, why the universe exists, why we exist. It is not necessary to invoke God to light the blue touch paper and set the universe going.[2] (emphasis added)

Thinkers such as Hawking fall into this highly problematic understanding of nature by not recognizing the fact "that creation is first of all a category of metaphysical reflection…the radical causing of the whole existence of whatever exists."[3] Hawking improperly associates

[1] Genesis 1:1-2 (RSV)
[2] Stephen Hawking and Leonard Mlodinow, *The Grand Design* (New York: Bantam, 2012), 180.
[3] William E. Carroll, "Creation, Evolution, and Thomas Aquinas," *Revue des Questions Scientifiques* 171, no. 4 (2000): http://www.catholiceducation.org/articles/sc0035.html (accessed 20 October 2013).

the singularity[4] which seems to emerge in Big Bang cosmology with the event of creation. In his framework, by considering cosmological models that do not include an initial singularity, there is no need for a creation event and therefore no need for a Creator.

The father of Big Bang cosmology, Monsignor Georges Lemaître, never made the mistake of identifying the initial "flash" of the Big Bang with the event of creation because his thought was deeply rooted in Thomistic metaphysics as well as the tenets of modern mathematics and physics. Lemaître well understood that physical cosmology studies *change*, and creation is not a change.[5] Indeed, as the contemporary British theologian, William E. Carroll, succinctly points out, the fact that the empirical sciences study *change* "excludes an absolute beginning of the universe from their purview, since such a beginning could not be a change. Any change presupposes some reality which is there to change."[6] Empirical science offers a mathematical description of nature but, as the French historian of science, Pierre Duhem (1861 – 1916) said, "science does not explain."[7] Expanding on this thought, the contemporary Italian-American mathematician, Carlo Lancellotti, stated in an address at Baylor University: "[Science] does not address the metaphysical question of how the object can be and [how it can] be formed. Rather, in Scholastic terminology, science only knows the object *qua* a certain aspect of its being. This is where trouble can begin, if the abstraction is not recognized as such and claims to exhaust the intelligibility of the object."[8]

According to Pope Benedict XVI, the orthodox Christian knows by reason and faith that "the universe is not the result of chance, as some would like to make us believe. In contemplating it, we are asked to interpret in it something profound: the wisdom of the

[4] A singularity is a phenomenon in which the quantities that are used to measure the gravitational field become infinite. It is believed that the center of a black hole is a singularity as well.
[5] Elio Gentili and Ivan Tagliaferri, *Scienza E Fede : I Protagonisti : Sacerdoti E Religiosi Scienziati* (Rome: Istituto Geografico de Agostini, 1989), 287.
[6] Carroll, "Creation, Evolution, and Thomas Aquinas."
[7] Pierre Duhem, *Le Systeme Du Monde. Histoire Des Doctrines Cosmologiques De Platon a Copernic*, vol. I (Paris: Librarie Scientifique A. Hermann et Fils, 1913).
[8] Carlo Lancellotti, "Science, Contemplation, and Ideology," in *The World and Christian Imagination* (Baylor University: 2006), 5.

Creator, the inexhaustible creativity of God, [and] his infinite love for us."[9] Indeed, it was this very contemplation of the awesome creativity of God in the universe that provided the fertile ground for the emergence of empirical science for the first time in Christian Europe.

B. Pre-Christian Views of Creation and the Impact on Science

It is noteworthy that given the splendid simplicity of the fact of creation, the most advanced ancient civilizations failed to grasp it. The Hungarian-American scholar, the Reverend Stanley L. Jaki, O.S.B. (1924 – 2009), diligently studied the history of science and noted the effect that pagan religion had on both the common-sense understanding of the natural world as well as the unsuccessful attempts to develop empirical science in ancient civilizations. Unlike the pagan religions of antiquity, e.g. ancient Egypt, Christianity never sought to explain the physical phenomena of the material world as a dramatic struggle between warring gods and goddesses, i.e. μύθος (myth). The created world can only be understood through the God-given gift of reason, properly ordered. He who created the κόσμος (cosmos) is λόγος (logos) - Reason, Himself. According to St. Athanasius of Alexandria (c. 296-298 – 373), the order of the cosmos is a motive of credibility for Christ and His Church:

> For if the movement of the universe was irrational, and the world rolled on in random (i.e. indeterminate) fashion, one would be justified in disbelieving what we (i.e. Christians) say. But if the world is founded on reason, wisdom, and science, and is filled with orderly beauty, then it must owe its origin and order to none other than the Word of God.[10]

The Christian theology of creation must be distinguished from pantheism, a common problem of the pre-Christian cultures. The three pantheistic understandings of creation typical to pre-Christian cultures are procession, emanation, and transformation:

1) *Procession* occurs when, without division of substance, an immutable nature is completely given to several persons: this is the case in the Mystery of the Most Holy Trinity.

[9] Benedict XVI, "Homily for Feast of the Epiphany," (2011): http://www.vatican.va/holy_father/benedict_xvi/homilies/2011/documents/hf_ben-xvi_hom_20110106_epifania_en.html (accessed 4 January 2014).
[10] St. Athanasius, "Discourse against the Pagans," *(quoted in) The Liturgy of the Hours* vol. 3, (1974): 67.

2) *Emanation* takes place when a being draws forth from its own substance another similar or analogous substance as a separate reality, or else produces within itself a new manner of being, distinct from itself.
3) *Transformation* occurs when an external agents causes a change of a state within another being.[11]

The Christian theology of creation is radically different from all the pre-Christian creation and cosmogonic myths because it is rooted in "God's absolute power bringing into being outside of Himself something which in no way existed before."[12]

Egypt

The accomplishments of the ancient Egyptians were copious. One may recall the extraordinary civil engineering skills that permitted the construction of the pyramids, the sophistication of the phonetic writing system known as Hieroglyphics, the mathematical prowess to define and solve quadratic equations, and the feat recounted by the Greek historian, Herodotus, of the circumnavigation of Africa some 2000 years before Vasco da Gama.[13] Despite the brilliance of this ancient civilization, the Egyptians never developed empirical science, given the constraints on reason arising from their religious beliefs. In all the creation myths of the Egyptians, the world emerged from an infinite, lifeless chaotic sea at the first sunrise.[14] The Egyptian religion deified nature, animals, and the Pharaoh. It sought to maintain the order (*Ma'at*) of the universe through sacrificial offerings to the gods thereby perpetuating the cycles of nature on which they relied, e.g. the annual flooding of the Nile.[15] The "forces of nature" for the Egyptians were the gods themselves. Therefore, it would have been foolish for them to try to understand them through mathematical modeling

[11] Paul Haffner, *Mystery of Creation* (Leominster: Gracewing, 2010), 2.
[12] Ibid.
[13] Stanley L. Jaki, *The Savior of Science* (Port Huron: Real View Books, 2006), 22-24.
[14] James P. Allen, *An Introduction to the Language and Culture of Hieroglyphs* (Cambridge: Cambridge University Press, 2000), 466.
[15] Jan Assmann, *The Search for God in Ancient Egypt*, trans., David Lorton (Ithaca: Cornell University Press, 2001), 68-79.

and experiment. As the Psalmist said: "…the gods of the heathens are naught. It was the Lord who made the heavens…"[16]

India

A similarly tragic story can be told of the ancient Hindus. The contributions of the Hindus to pure mathematics were quite significant. They seem to have been the first to develop the decimal numbering system. Hindus also defined the trigonometric functions of *sine* and *cosine*[17], described a theory of numbers that included zero and negative numbers, and crafted an algebra.[18] Nevertheless, the Hindus viewed the universe as an animistic reality with, according to the *Rigveda*, at least thirty-three deities corresponding to natural phenomena.[19] A striking pantheism is clear in their various creation myths. Jaki recounts two emanationist scenarios: "One was a huge egg in the womb of a deity with bisexual powers. Another was the fathomless waters representing the body of Vishnu where, out of every hair-follicle, a universe bubbled forth…"[20] The Hindus also believed in a tragic birth-life-death-rebirth cycle that has neither beginning nor end. Like their neighbors in Egypt, given this conception of the universe, it is not surprising that principles of empirical science were never developed.

China

The ancient Chinese are well known for their "four great inventions": the compass, gunpowder, papermaking, and printing. These extraordinary accomplishments indicate a sophisticated practical understanding of magnetism, chemistry, and metallurgy. In contrast, the religious situation in ancient China was very muddled with many overlapping polytheistic systems that were intrinsically syncretistic. The Chinese adopted elements from what is now called "Chinese folk religion," Confucianism, Taoism, and Buddhism. Unlike the creation

[16] Psalm 96:5 (Grail Psalter 1963)
[17] Nicolas Bourbaki, *Elements of the History of Mathematics* (New York: Springer-Verlag, 1998), 126.
[18] Ibid., 46-49.
[19] Alain Daniélou, *The Myths and Gods of India* (Rochester, VT: Inner Traditions, 1991), 78-84.
[20] Jaki, 26.

myths of the other major pagan religions, the Chinese stories are more properly called "cosmogonic myths" because they lack any sense of a creator. These myths vary greatly but generally fit into the paradigms of emergence from chaos, emergence from a dismembered corpse of a primordial being, emergence from "world parents," or dualistic cosmogonies such as the *yin-yang*.[21] Given the considerable confusion about nature, natural science could never emerge.

Mesopotamia

A similar story may be told of ancient Mesopotamia. The foundations of the city of Babylon were probably laid by the Sumerians and Akkadians. It was later ruled by the Amorites, the Assyrians, the Chaldeans, the Persians, the Greeks, the Romans, and finally the Arabs. Before ~3200 B.C., the Sumerians had developed the first writing system: cuneiform. Cuneiform clay tablets dating from 1800 to 1600 B.C. indicate Babylonian knowledge of solving quadratic and cubic equations.[22] In addition, a great tradition of astronomical observation goes back to the Sumerians in the Bronze Age. This quest led to the development of star catalogues, some of which endure to this day. The ancient Babylonians were also probably the first civilization to elaborate a functional theory of planetary motion.[23]

Regrettably, astronomy was often mixed with astrolatry – the worship of celestial bodies as gods. Therefore, as Jaki points out, it is no surprise that the Babylonian cosmogony referred to as the *Enuma Elish* is "a portrayal of personified forces of nature locked in deadly battles. The crowning phase is the dismemberment of the body of *Tiamat*, the mother goddess, for the purpose of forming from its pieces the main parts of the world: the sky, the

[21] Anne Birrell, *Chinese Mythology: An Introduction* (Baltimore: Johns Hopkins University Press, 1993).
[22] John J. O'Connor and Edmund F. Robertson, *An Overview of Babylonian Mathematics*, The Mactutor History of Mathematics (2000), http://www-history.mcs.st-andrews.ac.uk/HistTopics/Babylonian_mathematics.html (accessed 16 November 2013).
[23] Asger Aaboe, "Scientific Astronomy in Antiquity," *Philosophical Transactions of the Royal Society* 276, no. 1257 (1974): 21-42.

earth, the waters, and the air."[24] Unfortunately, it is difficult for pantheism to motivate scientific research into the structure of nature.

Greece

Despite the overwhelming polytheism of the ancient Greeks, a few luminaries emerged that were second to none in the ancient world for their understanding of mathematics and science. The Syracusan, Archimedes (c. 287 B.C. – c. 212 B.C.), was unquestionably the greatest physical scientist of antiquity, having made major contributions in optics, statics, hydrostatics, mechanical engineering, geometry, series formulations, and infinitesimals.[25] Similarly, the Macedonian, Aristotle (384 B.C. – 322 B.C.), was an exceptional life scientist, excelling in zoology. However, unlike Archimedes, he was also *deeply* interested in metaphysical questions.

While the vast majority of Greek worshipped the twelve gods of Mount Olympus, some of the philosophers spoke of a single god, or demiurge that *formed* (rather than created) the world. A very well-known cosmogonic myth is found in Plato's Τίμαιος (Timæus). Plato believed in two worlds: the material world and the eternal world of ideal forms. He suggested that the demiurge, inspirited by the perfect world of forms, brought order to the chaos of the physical world (that formerly existed) in which the four elements: earth, water, fire, and air were previously haphazardly mixing. This physical world was also given a world-soul by the demiurge.[26]

Plato's disciple, Aristotle, posited an "Uncaused Cause," a sort of "philosophical" monotheism.[27] Nonetheless, in his book, the *Physics*, he too offered an argument for the eternity of the universe. Aristotle believed in a ὑποκείμενον (hypokeimenon), i.e. a material

[24] Jaki, 39.
[25] John J. O'Connor and Edmund F. Robertson, *Archimedes of Syracuse*, The Mactutor History of Mathematics (1999), http://www-history.mcs.st-and.ac.uk/Biographies/Archimedes.html (accessed 16 November 2013).
[26] Plato, *Timæus*, 27c-37c.
[27] Julián Marías, *History of Philosophy*, trans., Stanley Appelbaum and Clarence C. Stowbridge (Mineola: Dover Publications, 1967), 59-82.

substratum, from which all matter comes into existence. In order to avoid the problem of the infinite recursion of substrata in finite time, i.e. $substratum_x$ came from $substratum_{x-1}$ which came from $substratum_{x-2}$, etc., he posited an eternal universe.[28]

Interestingly, some of the disciples of Plato centuries later, such as Plotinus (c. 204/5 – 270 A.D.) and Porphyry of Tyre (c. 234 – c. 305 A.D.), also did not completely accept the veracity of the myths. These philosophers however asserted a Neo-Platonic monotheism not open to the revelation of Jesus Christ. In opposition to the Christian doctrine of creation *ex nihilo*, Plotinus posited a pantheistic doctrine of emanation *ex deo*.[29] Porphyry on the other hand "tried to play both sides": supporting the official imperial cults while also suggesting a theoretical monotheism.[30] Sadly, the empirical investigations of Archimedes and Aristotle could not be sustained by future generations of Greeks who either believed the world was governed by the "Olympian Heroes" or attempted to maintain societal polytheism along with personal, philosophical monotheism.

Pre-Colombian Americas

Empirical science also never developed across the Atlantic Ocean in the great civilizations of the Americas. Like the other pagan cultures throughout the world, the Pre-Colombian American peoples held a cyclical world view in which the world was governed by gods exceptional for their cruelty – particularly desiring human sacrifice.[31] The Aztec Empire, centered around modern day Mexico City, distinguished itself in many of the practical arts: particularly agriculture and architecture. They developed many innovative techniques for irrigation, domesticated various animals such as the wild turkey, as well as constructed vast cities and immense structures such as the Great Pyramid of Tenochtitlan.

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[28] Aristotle, *Physics*, vol. I, 7.
[29] Brian Morley, "Western Concepts of God," in *Internet Encyclopedia of Philosophy*, ed. James Fieser and Bradley Dowden(2014), http://www.iep.utm.edu/god-west/ (accessed 12 March 2014).
[30] Robert M. Berchman, *Porphyry against the Christians* (Leiden, the Netherlands: Koninklijke Brill, 2005), 22.
[31] In 1487, according to the account of King Ahuitzotl, the Aztecs may have sacrificed 80,400 prisoners over the course of four days at the Great Pyramid. See Ross Hassig, "El Sacrificio Y Las Guerras Floridas," *Arqueología Mexicana* XI, (2003): 47.

However, the Aztec understanding of the natural world was deeply rooted in myth. For the Aztecs, the universe was initially a void in which at some time a "dual god," *Omecihuatl*, "created" itself. Next, according to the "Legend of the Five Suns," a cyclical tale unfolds of the creation and destruction of five different worlds by jealous, lustful, vengeful gods.[32]

To the south of the Aztecs was the Mayan Empire, which composed what is now southern Mexico and Central America. The Mayans were the only Pre-Colombian civilization to develop a complete written language. They also developed base-5 and base-20 numbering systems as well as a concept for the number zero. A strong interest in astronomy led them to predict the motion of some celestial bodies and develop a sophisticated solar calendar.[33] The Mayan religion worshipped a variety of deities such as "sky gods" (e.g. a sun god), weather gods (e.g. a lightning god), occupational gods (e.g. a midwife helper god), animal gods, dwarfs, and goblins. According to the Mayan creation story, the *Popol Vuh* myth, two creator gods, *Gucumatz* and *Tepeu*, "formed" the earth out of the primordial sea. Later in the process, the gods attempted to form man, unsuccessfully time after time using inadequate materials. Finally, man is formed from maize, the staple of Mayan cuisine.[34]

The largest Pre-Colombian civilization was the Inca Empire, established in what is now Peru. The Incas, like their northern neighbors, had a strong interest in astronomy. They did not reach a level of sophistication that would enable them to predict an eclipse like their neighbors, but they were able to develop a parallel calendar system: both lunar and solar.[35] The Incas also developed a base-10 number system which enabled developments in engineering, architecture, and societal administration.[36] Perhaps most significantly, the Inca

[32] Angel Vigil, *The Eagle on the Cactus: Traditional Stories from Mexico*, trans., Francisco Miraval (Englewood, CO: Greenword Publishing, 2000), 39-47.
[33] O'Connor and Robertson, *Mayan Mathematics*, The MacTutor History of Mathematics, http://www-history.mcs.st-and.ac.uk/HistTopics/Mayan_mathematics.html (accessed 20 March 2014).
[34] *The Popol Vuh*, trans., Lewis Spence (1908), http://sacred-texts.com/nam/pvuheng.htm (accessed 20 March 2014).
[35] Terence N. D'Altroy, *The Incas* (Malden: Blackwell Publishing, 2005), 150-154.
[36] Ibid., 233-234.

Empire was particularly ambitious in the area of medicine. They successfully utilized the coca plant for pain management and evidence exists that they performed successful neurosurgery to relieve cranial pressure due to traumatic head injury.[37] The Incas believed in three categories of gods: celestial gods, gods that lived in the realm of men, and the gods of the underworld. In their creation myth, the creator god *Viracocha* emerged from Lake Titicaca and formed the sun, moon, and stars. He later went on to form men out of large stones but *Viracocha* was displeased with them so he destroyed them with a flood. He later formed another race of men using smaller stones.[38]

All of the major Pre-Colombian cultures manifested many impressive features. Nonetheless, their commitment to pantheism and associated creation myths hindered any serious study of the natural world. This is seen most strikingly in the pre-supposition that human sacrifice was necessary to sustain the universe. The belief that the natural world required the ritualistic murder of human beings to maintain celestial bodies, promote crop growth, and support animal life, etc. absolutely precluded the possibility of developing natural science.

Islam

While Islam – literally submission – arose in the seventh century A.D., the continuing influence of its pre-Christian origins is dominant in the field of creation and science so it is treated in this section. Mohammed, the founder of Islam, was born in Mecca around 570 A.D., a member of the *Banu Hashim* clan. His clan, like their fellow Arabs, worshipped an amalgamation of demons, genies, and demigods. The principle deity on the Arabian peninsula was *Hubal*, and he was worshipped along with 359 other deities at a shrine called

[37] Scott Norris, "Inca Skull Surgeons Were 'Highly Skilled,' Study Finds," in *National Geographic News* (12 May 2008), http://news.nationalgeographic.com/news/2008/05/080512-inca-skulls.html (accessed 20 March 2014).
[38] Kenneth McLeish, *Viracocha*, Bloomsbury Dictionary of Myth (London: Bloomsbury Publishing Ltd., 1996).

the *Kaaba*.[39] The *Kaaba* was built in Mecca over a meteorite strike site because the meteorite was seen as a gift from the gods.[40] It is significant that after creating the Muslim religion, Mohammed transformed the *Kaaba* into the largest and most sacred *mosque* in Islam, the *Al-Masjid al-Haram*, to which Muslims are obligated to make the *Hajj* pilgrimage. As the pre-Muslim Arabs worshipped a variety of moon deities, it is not surprising also that Islam has a lunar calendar and a crescent moon, the *Hilal*, as an identifying symbol.[41] In fact, the sighting of the *Hilal* initiates the holy season of *Ramadan*.

Within Islam, one notices elements of Arianism, the form of Christianity to which Mohammed was exposed, e.g. affirming monotheism while denying the divinity of Jesus Christ, as well as a continuation of certain elements of the local tribal religion, e.g. polygamy. The Koranic emphasis of the will of *Allah* over his reason certainly does not encourage a harmonious relationship between faith and reason typical of orthodox Christianity, and a robust theology of creation. Ultimately, despite the late appearance of Islam, the Judeo-Christian sources of Revelation from which it borrowed (including the Genesis creation account), and access to the intellectual heritage of the Egyptians, Babylonians, and Greeks, empirical science never flourished in the Muslim world.

C. Pre-suppositions of a Christian Theology of Creation

The Christian theology of creation has always been established upon two pillars: the perennial insights of ancient, pre-Christian Greek philosophy and the *datum* of divine revelation. A crucial component of Aristotle's epistemology was his moderate realism. The approach of moderate realism "declares that there are universal concepts representing faithfully realities that are not universal."[42] That is, universals exist insofar as they are instantiated in specific entities, e.g. "dog" is a valid universal as it is instantiated in the

[39] Karen Armstrong, *Islam: A Short History* (New York: Modern Library, 2002), 3-11.
[40] Karen Armstrong, *Jerusalem: One City, Three Faiths* (New York: Ballantine Books, 2005), 221.
[41] Prudence Jones and Nigel Peninck, *A History of Pagan Europe* (New York: Routledge, 2000), 77.
[42] Maurice De Wulf, "Nominalism, Realism, Conceptualism," in *The Catholic Encyclopedia* (New York: Robert Appleton Company, 1911), http://www.newadvent.org/cathen/11090c.htm (accessed 14 November 2013).

various animals that exhibit "dogness." Moderate realism may be placed on a spectrum between exaggerated realism and nominalism. Exaggerated realism "holds that there are universal concepts in the mind and universal things in nature"[43] as suggested by Plato's ideal forms. On the other hand, nominalism "denies the existence of abstract and universal concepts, and refuses to admit that the intellect has the power of engendering them." [44] Nominalism was exemplified by Frater William of Ockham, OFM (c. 1287 – 1347), who denied the real existence of metaphysical universals and encouraged the diminution of ontology.[45]

Against the denials of truth that are erroneous *in se* but particularly detrimental to understanding the compatibility of theology of creation with the natural sciences, moderate realism:

1) affirms universal concepts – against nominalism;
2) affirms that reality extends beyond that which empirical science can measure – against positivism and empiricism;
3) affirms the value of the scientific method *in se* – against the instrumentalism that maintains the merely practical value in the field of scientific research;
4) affirms the objective existence of the external world – against idealism;
5) affirms that reality has meaning – against nihilism; and
6) affirms the unity of being – against existentialism which asserts that related entities are totally disconnected from each other.[46]

Indeed, Pope Paul VI, in a *motu proprio* commonly referred to as the *Credo of the People of God*, reminded the Church of the full capacity of God's gift of intellect against some of the aforementioned epistemological problems:

> It is of the greatest importance to recognize that over and above what is visible, the reality of which we discern through the sciences, God has given us an intellect which can attain to *that which is*, not merely the subjective content of the "structures" and the developments of human consciousness.[47]

[43] Ibid.
[44] Ibid.
[45] William Turner, "William of Ockham," in *The Catholic Encyclopedia*(New York: Robert Appleton Company, 1912), http://www.newadvent.org/cathen/15636a.htm (accessed 14 November 2013).
[46] Haffner, 2-6.
[47] Paul VI, *Solemni Hac Liturgia* (30 June 1968), 5.

When man fully acknowledges the powers of intellect that he has received, he is able to begin to understand the natural world in which he finds himself as well as receive the gift of supernatural revelation. The contemporary English theologian, the Reverend Paul Haffner, observes that "creation theology is one area where the interface between human thought and Christian belief stands out in bold relief. Through reason, man studies creation in search of its Creator. Through revelation, God enters His own creation in search of man."[48]

The fact of creation is accessible to man through reason alone, as taught clearly by the Scriptures in both the Old and New Testaments:

Wisdom 13:1-9 (RSV)	**Romans 1:19-20 (RSV)**
1 For all men who were ignorant of God were foolish by nature; and they were unable from the good things that are seen to know him who exists, nor did they recognize the craftsman while paying heed to his works; 2 but they supposed that either fire or wind or swift air, or the circle of the stars, or turbulent water, or the luminaries of heaven were the gods that rule the world. 3 If through delight in the beauty of these things men assumed them to be gods, let them know how much better than these is their Lord, for the author of beauty created them. 4 And if men were amazed at their power and working, let them perceive from them how much more powerful is he who formed them. 5 For from the greatness and beauty of created things comes a corresponding perception of their Creator. 6 Yet these men are little to be blamed, for perhaps they go astray while seeking God and desiring to find him. 7 For as they live among his works they keep searching, and they trust in what they see, because the things that are seen are beautiful. 8 Yet again, not even they are to be excused; 9 for if they had the power to know so much that they could investigate the world, how did they fail to find sooner the Lord of these things?	19 For what can be known about God is plain to them, because God has shown it to them. 20 Ever since the creation of the world his invisible nature, namely, his eternal power and deity, has been clearly perceived in the things that have been made. So they are without excuse;

[48] Haffner, 6.

Realizing the importance of this teaching, the Church solemnly defined it at the First Vatican Council in the dogmatic constitution, *Dei Filius*:

> The same Holy Mother Church holds and teaches that God, the beginning and end of all things, can be known with certainty from the things which were created through the natural light of reason.[49]

A beautiful expression of this teaching was given by Pope Benedict XVI in his homily for the Solemnity of the Epiphany of the Lord in which he observed that the pagan Magi "were people certain that something we might describe as the 'signature' of God exists in creation, a signature that man can and must endeavor to discover and decipher."[50]

Fascinatingly, the Old and New Testaments also *reveal* the doctrine of creation:

2 Maccabees 7:28 (RSV)	**Romans 4:17 (RSV)**
I beseech you, my child, to look at the heaven and the earth and see everything that is in them, and *recognize that God did not make them out of things that existed*. Thus also mankind comes into being.	…as it is written, "I have made you the father of many nations" – in the presence of the God in whom he believed, who gives life to the dead and *calls into existence the things that do not exist*.

Moreover, Wisdom literature and the Psalms teach that the origin of creation is found in the awesome, creative *Verbum Dei*, e.g. "Let all the earth fear the LORD, let all the inhabitants of the world stand in awe of Him! For He spoke, and it came to be; He commanded, and it stood forth."[51]

Through the gift of the Sacred Tradition, a more complete doctrine has been taught and guarded by the Magisterium since the earliest days of the Church. Over the centuries, the contributions of numerous theologians, many of them *doctores ecclesiae*, have deepened the Church's understanding of the mystery of creation. Regrettably, in defiance of the Magisterium, three classes of inadequate Biblical interpretations have emerged, largely since the sixteenth century, and have led to flawed perceptions of creation. These deficient

[49] Vatican I, *Dei Filius* (1870), Chapter 2 "On Revelation" in DS 3004. English Translation form ND 113.
[50] Benedict XVI, "Homily for Feast of the Epiphany," http://www.vatican.va/holy_father/benedict_xvi/homilies/2011/documents/hf_ben-xvi_hom_20110106_epifania_en.html (accessed 4 January 2014).
[51] Psalm 33:8-9 (RSV)

approaches are commonly referred to as concordism, fundamentalism, and liberalism/modernism.

D. Modern Causes of Flawed Perceptions of Creation

Concordism

Concordism is the mistake of attempting to establish a strict concordance between the first chapter of the Book of Genesis with the most current physical cosmology. The nature of empirical science is that it is continually evolving with occasional paradigmatic shifts. As scientific views change, the faith of a concordist could be weakened if the *Verbum Dei* is tied too closely to scientific theories. One of the most famous examples of concordist exegesis comes from the Irish Anglican Archbishop of Armagh, James Ussher (1581 –1656). Ussher attempted to establish a concordance between the Biblical story of creation and his understanding of the universe utilizing Newtonian physics. His research led him to declare that the universe was created at 9AM, Sunday, October 23, 4004 B.C.![52] Unfortunately, the problem of concordism strongly reemerged in the twentieth century with the development of Big Bang cosmology. As mentioned earlier, Monsignor Georges Lemaître, the father of the Big Bang, was an adamant opponent of this problematic interpretation.

Fundamentalism

The seeds of Biblical fundamentalism were planted by the sixteenth century Reformers as a result of their new doctrine of *sola Scriptura*. However, some of the consequences of this new approach to the Bible did not manifest themselves until the nineteenth century in reaction to modernism. Largely a British and American phenomenon, Biblical fundamentalism arose in response to the writings of liberal, historical-critical exegetes who questioned the inspiration and inerrancy of Scripture as well as the veracity of particular events described in the Bible, such as the miracles of Christ. While rightly

[52] Haffner, 17-18.

upholding the *Verbum Dei* as inerrant and inspired, fundamentalism manifests a serious weakness in its understanding and application of the "literal sense of Scripture."

The great *doctor ecclesiæ*, St. Thomas Aquinas (1225 – 1274), points out that there are many senses to a Biblical text: historical or literal, allegorical, tropological or moral, and anagogical. This logically follows from the fact that:

> The author of Holy Writ is God, in whose power it is to signify His meaning, not by words only (as man also can do), but also by things themselves. So, whereas in every other science things are signified by words, this science has the property, that the things signified by the words have themselves also a signification. Therefore that first signification whereby words signify things belongs to the first sense, the historical or literal.[53]

The Pontifical Biblical Commission (PBC) has defined the literal sense in a very helpful way that is worth quoting at length:

> The literal sense is not to be confused with the "literalist" sense to which fundamentalists are attached. It is not sufficient to translate a text word for word in order to obtain its literal sense. One must understand the text according to the literary conventions of the time. When a text is metaphorical, its literal sense is not that which flows immediately from a word-to-word translation (e.g. "Let your loins be girt": Lk. 12:35), but that which corresponds to the metaphorical use of these terms ("Be ready for action"). When it is a question of a story, the literal sense does not necessarily imply belief that the facts recounted actually took place, for a story need not belong to the genre of history but be instead a work of imaginative fiction. The literal sense of Scripture is that which has been expressed directly by the inspired human authors. Since it is the fruit of inspiration, this sense is also intended by God, as principal author. One arrives at this sense by means of a careful analysis of the text, within its literary and historical context. The principal task of exegesis is to carry out this analysis, making use of all the resources of literary and historical research, with a view to defining the literal sense of the biblical texts with the greatest possible accuracy (cf. *Divino Afflante Spiritu*: Ench. Bibl., 550). To this end, the study of ancient literary genres is particularly necessary (ibid. 560).[54]

Fundamentalists typically ignore the linguistic, historical, and cultural aspects of divine revelation and therefore develop a naïvely literalist interpretation. As the PBC points out, fundamentalism typically presupposes a *sola Scriptura* approach to revelation which is intrinsically anti-ecclesial. By accepting "the literal reality of an ancient, out-of-date cosmology simply because it is found expressed in the Bible,"[55] a distorted view of the

[53] St. Thomas Aquinas, *Summa Theologiæ*, I, q. 1, a. 10, ad 1.
[54] Pontifical Biblical Commission, *The Interpretation of the Bible in the Church* (Vatican: Libreria Editrice Vaticana, 1993), https://www.ewtn.com/library/CURIA/PBCINTER.HTM (accessed 12 December 2013).
[55] Ibid.

relationship between Biblical faith and culture emerges. As a result, it is impossible to distinguish the teachings on faith and morals found in the Scriptures from the cultural practices of an ancient Middle Eastern culture. Other dangers also emerge from a non-critical reading of certain portions of the Scriptures that in the past have been manipulated to reinforce political ideologies or social norms that foster prejudices, such as racism. Finally, in adhering to the dogma of *sola Scriptura,* fundamentalism divorces the interpretation of the Sacred Text from the Sacred Tradition which has developed alongside the Bible and has also been guided by the inspiration of the Holy Spirit in the life of the Catholic Church.

Ultimately, fundamentalism fails to acknowledge the fact that the Spirit of God inspired ecclesial men, i.e. the Evangelists and Apostles, who preached the Sacred Tradition that was handed on to them by the Lord Himself. This Tradition took a written form in individual letters and testaments decades later and as a canon of Scripture centuries later. As the Church of Christ preceded the Bible, it should present no colossal hurdle for this same Church to claim to be its authentic interpreter. Nonetheless, the fundamentalist rejection of the authority of the Church regrettably leads them to dismiss the importance of the ancient Creeds, deny the doctrinal and liturgical aspects of ecclesial life, as well as reject the teaching office itself.[56] In a way similar to the ancient civilizations who deified nature, when the *text* of the Bible is in a sense "deified," it cannot be properly scrutinized to discern the many senses through which God desires to speak to men. It is not difficult to see how the fundamentalist, *sola Scriptura* approach is closed-off from a robust theology of creation and a healthy rapport between Christian faith and empirical science. This has been evidenced very strongly through the passionate reaction to the theory of evolution by fundamentalist Christians.

[56] Ibid.

Liberalism

As suggested in the previous section, the problem with the liberal or modernist approach to interpreting the Bible is quite different. The approach can be traced back to the German exegete, Friedrich Schleiermacher (1768 – 1834), who sought to reconcile Enlightenment values with traditional Protestantism through an aggressive application of hermeneutical analysis and criticism to Sacred Scripture. Schleiermacher's work led him to assert that religious *feeling* is the most authentic expression of the Christian religion. Furthermore, this feeling or intuition is primarily a sense of man's radical dependence on God.[57]

Following in the footsteps of Schleiermacher, modernists tend to diminish the Divine inspiration of the Scriptures and therefore the inerrancy as well, and exaggerate the role of human techniques in the formation of the Biblical texts. Profound truths of the faith are reduced to mere symbol or myth in liberal exegesis. A classic example of this is found in illegitimate comparisons between the creation story found in the Book of Genesis and Near-Eastern myths such as the *Enuma Elish*.[58] The (now retired) Episcopalian Bishop, John Shelby Spong, is a representative liberal theologian who carries out modernist exegesis, or more properly eisegesis (i.e. interpreting a text in such a way that it introduces one's own biases and presuppositions). Spong rejects the Biblical doctrines of creation, the fall, original sin, atonement, and redemption:

> …Charles Darwin not only made us Christians face the fact that the literal creation story cannot be quite so literal, but he also destroyed the primary myth by which we had told the Jesus story for centuries. That myth suggested that there was a finished creation from which we human beings had fallen into sin, and therefore needed a rescuing divine presence to lift us back to what God had originally created us to be. But Charles Darwin says that there was no perfect creation because it is not yet finished. It is still unfolding. And there was no perfect human life which then corrupted itself and fell into sin, there was rather a single cell that emerged slowly over 4½ to 5 billion years, into increasingly complexity, into increasing

[57] Friedrich Schleiermacher, *On Religion: Speeches to Its Cultured Despisers*, trans., John Oman (New York: Harper & Brothers, 1958).
[58] Haffner, 19.

> consciousness. And so the story of Jesus who comes to rescue us from the fall becomes a nonsensical story…[59]

Yet again, the need to receive the Bible as a book of the Church and therefore to interpret it in accordance with the Tradition and the guidance of the Magisterium is evident.

[59] John Shelby Spong, "Sunday Night Interview with Bishop John Shelby Spong," in *Compass*, ed. Geraldine Doogue (2001), http://www.abc.net.au/compass/intervs/spong2001.htm (accessed 7 January 2014).

II. THE BIRTH OF EMPIRICAL SCIENCE

A. Co-development with the Theology of Creation

The fathers of the Church were the first to systematically develop a theology of creation. One father who stands out in particular is St. Basil the Great (c. 329 – 379), a Greek Catholic bishop from Cæsarea Mazaca in Cappadocia. A gifted preacher, St. Basil's *Hexæmeron* (the work of creation in six days) is described by the contemporary patrologist, Robert Louis Wilken, as "a profound meditation on the creation of the world as depicted in the book of Genesis as well as one of the most beautiful and polished works of Christian antiquity…"[60] Indeed, his theology of creation is so impressive that even his contemporary fathers, e.g. Sts. Ambrose and Augustine, consulted these homilies before preparing their own commentaries on the six days of creation in the Book of Genesis. St. Gregory of Nyssa, Basil's brother, recounts how he attempted through his preaching to guide his congregation from the "creation of what is visible and the beautiful things in the world to the knowledge of the Creator of all things."[61]

In his first homily, St. Basil wrote:

> It is a fitting beginning (*arche*), for one who intends to speak of the formation of the world must set forth the principle (*arche*) that prevails in the order of visible things…In the beginning (*arche*) God created the heaven and the earth." I am stupefied when I consider this thought. What shall I say first? How shall I begin (*archo*) my address?[62]

Preaching to a Greek congregation, Basil cited the Greek Old Testament, the Septuagint, and carried out a play on words using the Greek noun ἀρχή (*arche*) or the verb form (*archo*). *Arche* does not merely mean "beginning"; it also has the connotation of "origin" or "first principle/cause."[63] One of Basil's goals was to teach his Greek congregation that the

[60] Robert Louis Wilken, *The Spirit of Early Christian Thought* (New Haven: Yale University Press, 2003), 138.
[61] St. Gregory of Nyssa, "Apologetic Explanation of the Hexaemeron," *(quoted in) The Spirit of Early Christian Thought*, (2003): 140.
[62] St. Basil, "Hexaemeron," *(quoted in) The Spirit of Early Christian Thought*, (2003): 140.
[63] Henry George Liddell et al., *A Greek–English Lexicon* (Oxford: Oxford University Press, 1996), http://www.perseus.tufts.edu/hopper/text?doc=Perseus%3Atext%3A1999.04.0057&redirect=true (accessed 26 November 2013).

universe did not come into existence spontaneously as the pagans imagined, but on the contrary, was directly brought about by God Himself.[64]

Although not explicitly making the connection between the theology of creation and the emergence of the natural sciences, Wilken implicitly shows Basil's awareness of the impact of having a proper understanding of creation:

> Human beings can search the heavens, measure the distances of the stars, observe their revolutions…but unless they recognize that "God is the creator of the universe" they will see nothing as it truly is.[65] If the world is cut free from its creator, it loses its natural axis. The starting point…must be that an "intelligent cause stands behind the birth of the world"[66]…The world is not random or disordered, it came into being not by chance or spontaneously, but by God's wisdom and love.[67]

Basil was also very conscious of the impact of Plato's *Timæus* in the minds of his people. Against the mistaken belief that the world was formed by the act of a demiurge that imposed an order on shapeless, pre-existent matter, the fathers of the Church, including St. Basil, taught the Biblical doctrine that "creation was a single divine act in which matter was *created* as well as knitted together."[68]

From the Book of Genesis, it is revealed that the physical world was not realized *ab æterno* but had a true beginning *ex nihilo et cum tempore* and is directed to an end, a τέλος (*telos*). Creation is deeply purposeful and in addition to the meaning to be discovered in the original, awesome act, one can discern the hand of God in his ongoing work of guiding creation to its end – the manifestation of His supreme glory. St. Basil very eloquently expresses this truth:

> Being wise, He [i.e. God] made it [i.e. creation] everything that was most beautiful. Being powerful He made it very great. Moses almost shows us the finger of the supreme artisan taking possession of the substance of the universe, forming the different parts in one perfect accord, and making a harmonious symphony result from the whole.[69]

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[64] Wilken, 140.
[65] St. Basil, "Hexaemeron," I.4.
[66] Ibid., I.2.
[67] Wilken, 141.
[68] Ibid.
[69] St. Basil, *Hexaemeron*, ed. Philip Schaff, Henry Wace, trans., Blomfield Jackson, Nicene and Post-Nicene Fathers - Second Series, vol. 8 (Buffalo: Christian Literature Publishing Co., 1895), I.7 http://www.newadvent.org/fathers/32011.htm (accessed 2 December 2013).

St. Basil's younger brother, St. Gregory of Nyssa, continued his work in the theology of creation by writing *An Apology on the Hexæmeron,* in which he also emphasized the theme of the *logos*-centric character of creation.

The Bishop of Hippo (present day Algeria), St. Augustine (354 – 430), also made significant contributions to the theology of creation and established intellectual foundations amenable to the emergence of empirical science. After leaving the Manichean sect and requesting baptism in the Catholic Church (which he received from St. Ambrose in Milan in 387), Augustine sought to refute the problematic beliefs of the Manicheans, including their rejection of the Biblical story of creation. In 415 he authored *De Genesi ad Litteram,* a commentary on the Book of Genesis, in which he distinguished between two stages in the act of creation. The first stage was the actual creation of matter *ex nihilo,* and the second stage was the forming of this matter into the universe as we know it.[70]

While comparisons may be made between Augustine's second stage and Plato's vision expressed in the *Timæus*, Augustine's approach is unique because the second stage follows the first logically, not temporally. Inspired by a verse in the Latin translation of the Book of Sirach, "*Qui vivit creavit omnia simul*" (Sirach 18:1), St. Augustine wanted to maintain that creation was an instantaneous act. On the other hand, the fact remains that the first chapter of the Book of Genesis implies that there is a gradual process in which the various creatures were brought into being. As a result, Augustine utilized the Stoic doctrine of the Λόγοι σπερματικοί (logoi spermaticoi). He suggested that many creatures existed only potentially in a seminal form as *rationes seminales* (seed-principles) at the beginning of the universe, and then later, at the appropriate time, they would emerge in their proper form.[71]

[70] George V. Coyne and Michael Heller, *A Comprehensible Universe* (New York: Springer-Verlag, 2008), 48.
[71] Ibid.

One wonders if this theory had any influence on Charles Darwin as he was formulating his theory of evolution.

The contemporary physicists, the Reverend George Coyne, S.J. and the Reverend Michał Heller, point out that "this 'quasi-evolutionary' perspective of Augustine excluded a literal understanding of the six days of creation."[72] Augustine offered three explanations of the story in *De Genesi Contra Manichæos*:

1. The six days of creation and the day of rest on the seventh were intended to emphasize the importance of the Sabbath;
2. The seven days denote seven stages in the moral development of man;
3. They denote long epochs in world history.[73]

In *De Genesi ad Litteram – Imperfectus Liber*, he suggests that the seven day division in the story of creation should be interpreted as a popular exposition of the endogenous process governing the evolution of the cosmos.

Finally, St. Augustine helped break western culture out of the erroneous paradigm of cyclical time: "*Absit, inquam, ut nos ista credamus. Semel enim Christus mortuus est pro peccatis nostris; surgens autem a mortuis iam non moritur*…" (God forbid that we should ever believe this [the cyclic history]. Christ once died for our sins and rising again, dies no more…)[74] Augustine, rooting himself in the Biblical text, taught that God created the world *with* space and *with* time but that He exists *beyond* space and *beyond* time, i.e. in eternity. As Coyne and Heller point out, "the idea of linear time belongs now to the heritage of our culture."[75] In the centuries to come, the concept of modeling the evolution of physical systems over time could never have emerged if the pagan conception of the cyclic succession of worlds had not been shattered.

[72] Ibid., 48-49.
[73] Ibid.
[74] St. Augustine, *De Civitate Dei*, XII, 14 http://www.thelatinlibrary.com/augustine/civ12.shtml (accessed 6 December 2013).
[75] Coyne and Heller, 50.

By the time of the Carolingian Renaissance (late eighth century to the ninth century), the Christian academy began to intensify its study of creation. This quest continued well into the later medieval period and the general European Renaissance and was coextensive with the emergence of empirical science. Research in the empirical sciences was not limited to the typical friar-theologians in the universities or cathedral canons associated with medieval scholarship. It involved the heights of the ecclesiastical hierarchy. Two well-known prelates from the early medieval period involved in scientific research were Pope Sylvester II (c. 946-1003), the Pope who introduced Arabic numerals and the abacus to Christian Europe and Bishop Robert Grosseteste (c. 1168 – 1253), the bishop of Lincoln and founder of the "Oxford School," known for developing the tradition of experimental science.[76]

In 1215, Pope Innocent III convoked the Fourth Lateran Council. It treated a wide variety of ecclesial issues ranging from impediments to a valid marriage to calling a fifth crusade. With regard to the theology of creation, it dogmatically defined that the creation of the material and spiritual world was done by God *ex nihilo et cum tempore*[77] against the errors of the Albigensians, Cathars, and Waldesians who posited an "evil principle," the "author of sin," that created the material world and the human body.[78] Another significant event occurred in 1267 when, Étienne Tempier, Bishop of Paris, condemned a variety of Aristotelian positions that undermined God's freedom in creation. This stimulated a reflection on the contingency of creation and opened the way to a more rigorous empirical investigation of the created world.[79] The seeds were now planted for the flourishing of both a theology of creation and modern empirical science.

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[76] Joseph R. Laracy, "Priestly Contributions to Modern Science: The Case of Monsignor Georges Lemaître," *Faith* 42, no. 3 (2010): 16.

[77] "Deus…creator omnium visibilium et invisibilium, spiritualium et corporalium: qui sua omnipotenti virtute simul ab initio temporis utramque de nihilo condidit creaturam, spiritualem et corporalem, angelicam videlicet et mundanam: ac deinde humanam, quasi communem ex spiritu et corpore constitutam." Lateran IV, *Constitutions* (1215), Chapter 1 "Confession of Faith" in DS 428.

[78] Nicholas Weber, "Albigenses," in *The Catholic Encyclopedia*(New York: Robert Appleton Company, 1907). accessed 20 November, 2013 http://www.newadvent.org/cathen/01267e.htm.

[79] Paul Haffner, *Creazione E Creatività Scientifica* (Leominster: Gracewing, 2009), 55.

The seven *artes liberales* were the heart of medieval education (the *Trivium*: grammar, logic, rhetoric, and the *Quadrivium*: arithmetic, geometry, music, and astronomy). These liberal arts were ordered to the knowledge of God through natural philosophy which was founded on the presupposition that nature was governed by rational laws accessible to human inquiry. Thus, research into these rational laws was a praiseworthy endeavor, knowing that the hand of the Creator was expressed in creation, but never equating creation and Creator. This autonomy was unique to Christendom. While pagans continued to view the natural world as itself divine, Christians sought explanations for physical phenomena based on natural cause and effect.

The intellectual approach of the medieval Scholastics, i.e. Scholasticism, is not properly speaking a "philosophical system," but rather a "method of philosophizing and learning."[80] The method was particularly keen at resolving a contradiction or answering a question using linguistic or logical analysis and reflected the medieval appreciation for "distinction, definition, and tabulation."[81] In the Scholastic theology of creation, the material universe is seen to contain the "*imagines et vestigia Dei*" (images and traces of God). The great bishop and doctor of the Church, St. Anselm (c. 1033 –1109) said that "*Uno eodemque Verbo dicit seipsum et quaecumque fecit*"[82] (In one and the same Word He speaks of Himself and what He did). For the Scholastics, the created things of the cosmos are "*verba in Verbo et de Verbo*"[83] (the words in the Word and from the Word). Therefore, creation is an expression or symbol of God Himself.

Succinctly presenting the teaching of St. Thomas Aquinas in contemporary language, the evangelical theologian, James A. Fowler, points out that: "God, the *non-contingent* Being, created all things to be *contingent* upon Himself. The created order is not self-existent,

[80] Coyne and Heller, 57.
[81] C.S. Lewis, *The Discarded Image* (Cambridge, UK: Cambridge University Press, 1988), 10.
[82] St. Anselm, *Monologion*, 33.
[83] Gisbert Greshake, *Il Dio Unitrino: Teologia Trinitaria*, trans., Paul Renner, 3rd ed. (Brescia: Queriniana, 2000), 265, note 52.s

self-generative, self-sustaining, autonomous, independent, eternal or infinite. Only God is such; and what God is only God is."[84] (emphasis added) Creation is pure gift. Only the Lord is the one, according to the Scriptures, who gives life to all creatures, blesses them with food, and makes the rain fall and the sun shine on the just and the unjust, in order to express His love and care for His creation.

One of the great centers of learning in Europe during the High Middle Ages was the Cathedral School of Chartres. The intellectual treasures of antiquity were preserved and developed through the study of Aristotle, Cicero, Euclid, Pythagoras, and others.[85] During this period, the study of Aristotle in particular, occupied pride of place. The Dominican philosopher, theologian, and scientist, St. Albert the Great, made critical use of his insights as did his student, St. Thomas Aquinas. Aristotle's *Metaphysics*, which he called "first philosophy," was utilized for speculative philosophy itself as well as for theology. His *Physics* was also of great interest to medieval scholars. In his *Physics*, he developed a philosophy of nature (which he called second philosophy) that was a combination of metaphysics as well as natural science, e.g. his well-known geo-centric model of an eternal universe.[86]

The Aristotelian philosophy of nature studied material beings, i.e. bodies, as capable of motion and change. Motion and change are universal characteristics of any body and this insight was used to develop a metaphysics of material beings. Modern empirical science, on the other hand, beginning in the thirteenth century, takes a different approach and studies phenomena from the point of view of quantity, or more precisely, measure. As a result, the scope of physics became phenomena which are quantifiable, or measurable, and no longer focuses on material bodies from the point of view of being. The Angelic Doctor described

[84] James A. Fowler, *In the Beginning God Created* (Fallbrook: C.I.Y. Publishing, 2007), 39-40.
[85] Haffner, *Creazione E Creatività Scientifica*, 49.
[86] Joseph R. Laracy, "Christianity and Science: Confronting Challenges to Faith and Reason in the History of Philosophy and Theology," *Faith* 43, no. 5 (2011).

the philosophy of nature as the intelligible essential knowledge of *ens mobile* (being capable of motion, i.e. change) and the natural sciences as empirical, accidental knowledge of physical reality. Within the field of the natural sciences, Thomas also distinguished between the sciences based on mathematical models which are constructed from empirical data, e.g. mathematical physics, and the "empirio-schematic" sciences which are not highly mathematical, e.g. anatomy.[87]

B. The Structure of the Scientific Method

While the fathers of the Church developed the pagan Greek concept of rationality and purified their understanding of creation, it was the Scholastics who began to reason about creation in a novel way that gave birth to the method of empirical science. Coyne and Heller point out that: "The Greek concept of rationality, in particular, had to go through all the abstractions of medieval metaphysics and through all the intricacies of the Scholastic method in order to emerge as the rationality underlying modern science."[88] Scholastics excelled in particular in formulating precise definitions with which to build syllogisms and construct sound, logical arguments. This bore great fruit for developing the modern scientific method:

> Concepts live in definitions and in the adventures of solving problems, and in these fields medieval thinkers performed a useful service. Modern physics will be born as soon as Scholastic definitions (aimed at grasping the essence of things) change into definitions containing a recipe of how to measure a corresponding property (the so-called operational definitions). It seems that this latter step could not be accomplished without the former preparatory steps.[89]

The Scholastics also encouraged the emergence of natural science through their use of abstraction. The meticulous rules of philosophical abstraction that were at the heart of the medieval method of reasoning were easily transformed into a quantitative method ideal for exploring the natural world. Coyne and Heller point out that "abstraction became an art,

[87] Benedict M. Ashley, "The River Forest School and the Philosophy of Nature Today," in *Philosophy and the God of Abraham*, ed. Raymond J. Long, James A. Weisheipl (Toronto: Pontifical Institute of Mediaeval Studies, 1991), 1-16.
[88] Coyne and Heller, 59.
[89] Ibid.

subject to rigorous rules of Scholastic procedures and logical schemes. When these procedures and schemes changed into mathematical patterns, we shall already be within the method of modern science."[90] Finally, the great thinkers of the medieval period were immune from the philosophical difficulties common today of idealism, positivism, instrumentalism, nihilism, etc. because of their faith in a God who is the ultimate assurance of the rationality of the cosmos as well as the rationality of the human intellect.

It is important to note that some of the greatest physical scientists of the medieval period were churchmen. Nicholas of Oresme (1323 – 1382), Bishop of Lisieux, was a great mathematician and discovered how to combine exponents and developed graphs of mathematical functions. He utilized his mathematical prowess to solve physical problems such as explaining the motion of the Sun by the rotation of the Earth. He also developed a more rigorous understanding of acceleration and inertia. Cardinal Nicolas of Cusa (1401 – 1464), Bishop of Brixon, was a mathematician and astronomer. Cusa postulated non-circular planetary orbits, developed a mathematical theory of relative motion, and even used concave lenses to correct near-sightedness. Canon Nicolaus Copernicus (1473 – 1543) formulated a heliocentric model of the Solar System. This initiated the so-called Copernican Revolution that transformed empirical science. Finally, Father Francesco Cavalieri, S.J. (1598 – 1647), played a pivotal role in the development of calculus and made contributions in geometry, optics, and mechanics.[91]

These great cleric-scientists refined a method that would be epitomized by a great Catholic layman (a father whose two daughters became religious sisters), Galileo Galilei (1564 – 1642). Galileo has rightly earned by popular acclaim the title: "Father of Modern Science." As a young man, Galileo received his first education in a monastic school and felt a call to the priesthood. His father, on the other hand, had decided that he would be a layman

[90] Ibid.
[91] Laracy, "Priestly Contributions to Modern Science: The Case of Monsignor Georges Lemaître," 16.

and have a career in medicine and sent him off to the University of Pisa.[92] While there, he discovered that his true passion was not for medicine, but for mathematics and natural philosophy.

Although Niccolò Fontana Tartaglia (c. 1499 –1557) and his disciple, Gianbattista Benedetti (1530 –1590), made some progress in developing the laws of motion, their thought was too wedded to the errors of Aristotelian physics. Coyne and Heller point out that "it was Galileo who developed the correct theory of a material point moving under the action of a constant force, i.e. the theory of uniform motion and that of uniformly accelerated motion of a material point. Although Galileo never used the term 'principle of inertia,' the fact that he applied this principle to his theory of uniform motion makes him its discoverer."[93] The American philosopher and theologian, the Reverend William A. Wallace, O.P., highlights the fact that Galileo's mathematical analyses are really a further elaboration of a tradition developed by the Scholastic natural philosophers that preceded him and with whose work he was very familiar.[94] Nonetheless, his creative genius allowed him to bring about a paradigmatic revolution in natural science.

More significant than particular contributions to classical mechanics was Galileo's method of doing empirical science: acknowledging the mathematical structure of reality, applying quantitative methods to model the natural world, formulating a hypothesis based on the model, testing the hypothesis through experimentation, and revising/refining the hypothesis based on the results of the experiments to define a theory. This approach to science has stood the test of time and has been utilized in the last century by such great physicists as Max Planck (1858 –1947) and Albert Einstein (1879 – 1955). The previous, Aristotelian scientific paradigm was rooted in knowledge through *causes* (material, efficient,

[92] James Reston Jr., *Galileo: A Life* (Washington, D.C.: Beard Books, 2000), 4.
[93] Coyne and Heller, 63.
[94] William A. Wallace, *Galileo and His Sources: The Heritage of the Collegio Romano in Galileo's Science* (Princeton: Princeton University Press, 1984).

formal, and final). However, "numbers" are not properly speaking a "cause" (αἴτιον) so the proper role of mathematics was neglected in Aristotelian physics. In his 1623 work, *Il Saggiatore*, Galileo wrote "Philosophy is written in this grand book, the universe…It is written in the language of mathematics, and its characters are triangles, circles, and other geometric figures…"[95]

C. Threats to Science and Faith

Empiricism

Despite the robustness of the Galilean method, further developed by the extraordinary physicists to succeed him in the coming centuries such as Sir Isaac Newton (1642 – 1727), Michael Faraday (1791 – 1867), and James Clerk Maxwell (1831 – 1879), three philosophical schools have emerged that threaten both the intelligibility of the natural sciences as well as Christian faith: empiricism, idealism, and intelligent design. The term "empiricism" is associated with a variety of diverse epistemologies. An essential distinction must be made between the *strict* empiricism epitomized by the British empiricists and ancient skeptics and the mitigated, *metaphysical* empiricism expressed in the thought of Aristotle and St. Thomas Aquinas. In both systems, sense experience is the common starting point. However, a metaphysical empiricist affirms that human knowledge begins with sense experience, while a strict empiricist ultimately reduces all knowledge to sense experience.[96]

One of the problems with the doctrine of the strict empiricists was their denial of the fact that *immateriality* is the root of knowledge:

> To know a stone or a triangle, for example, ultimately means knowing it in an intelligible or immaterial way; and even though knowledge does presuppose physiological modifications in the organic faculties of a knowing subject, these changes alone are not yet knowledge as such…Suffice it to say that the transition from sense knowledge to intellectual knowledge is not something we are conscious of: we discover it *a posteriori* through philosophical reflection. Of course, when the ancients questioned the how of things, they assumed that there

[95] Stillman Drake, *Discoveries and Opinions of Galileo* (New York: Doubleday & Company, 1957), 237-238.
[96] Richard B. DeBrasi and Joseph R. Laracy, "An Empirical Critique of Empiricism," *Logos* 16, no. 4 (2013): 125.

> was some sense to this "how" or "why," both of which are synonyms for the experience of "causality."[97]

Sadly, as a result of the influence of the Scottish philosopher, David Hume (1711 – 1776), this error of epistemology led to perhaps a greater blunder in the area of causality. Causality must be understood to be an *ontological relationship of dependence*. Otherwise, the natural sciences inevitably become an absurd quest that withdraws into the inter-subjectivity of minds that "define external reality against scientific models that are adopted today and replaced tomorrow."[98]

This problem became very apparent in the twentieth century with the philosophical preferences of Niels Bohr (1885 – 1962) and Werner Heisenberg (1901 – 1976). These two brilliant physicists suggested an interpretation of quantum mechanics in which indeterminism assumed a role never before envisioned in the history of science. As a result, the crucial distinction between ontological matters and empirical inquiry was ignored. Physics was reduced to a "formal or quantitative description of relations among perceptions."[99] The metaphysical inference that takes place in the cause-effect reasoning implicit in ordinary, day-to-day thought, as well as in the scientific method of Galileo, was jettisoned.

This devastating blow to the philosophy of science is equally harmful to Christian faith. A philosophical system rooted in skepticism denies the immateriality of knowledge, rejects the principle of causality rooted in ontological dependence, and suggests an indeterminism intrinsic to creation. It cannot be open to divine revelation, whether natural or supernatural. Indeed, the three theological virtues at the heart of the Christian Gospel: *fides, spes, et caritas*, can have no meaning for an empiricist. Man falls into doubt, despair, and indifference without the spiritual benefits of these virtues. Furthermore, the love of God

[97] Ibid., 138-139.
[98] Ibid., 142.
[99] Ibid., 143.

expressed in the incarnation, life and ministry, passion, death, and resurrection of Jesus the Christ cannot be received by one who has cast his lot with the strict empiricist.

Idealism

The problem of idealism was referred to earlier in the paper and the term represents a range of epistemologies which assert that reality, or reality as far as it can be known, is basically a mental construct. While this philosophical crisis can eventually be traced back to seeds planted in ancient Greece, it emerged very strongly during the modern period in Protestant Europe. The Irish Anglican Bishop, George Berkeley (1685 –1753), and other "subjective idealists" would assert that the corporeal world is only "perceived being": *esse est percipi* (to be is to be perceived). This form of idealism, sometimes referred to as immaterialism, denies the very existence of the "non-mental."[100]

Conversely, the "transcendental idealists," such as the Prussian philosopher, Immanuel Kant (1724 – 1804), would posit only an epistemological, (non-metaphysical) idealism. Kant wrote that "the reality of external objects is not capable of any strict proof. On the other hand, the reality of the object of our internal sense (that is, myself and my internal state) is clear immediately through consciousness."[101] Fundamentally, Kant took human subjectivity and elevated it to transcendental subjectivity. The ancient definition of truth articulated by St. Thomas as *adæquatio rei et intellectus* (correspondence of the intellect and the thing) was rejected in favor of a consistent ordering of the information coming from the senses.

These philosophical foundations infiltrated empirical science by the end of the nineteenth century. At that time, the English mathematician, Karl Pearson (1857 – 1936), confidently wrote that "there are many signs that a sound idealism is surely replacing, as a

[100] Lisa Downing, "George Berkeley," in *The Stanford Encyclopedia of Philosophy*, ed. Edward N. Zalta(2013), http://plato.stanford.edu/archives/spr2013/entries/berkeley/ (accessed 12 December 2013).
[101] Immanuel Kant, *Critique of Pure Reason*, trans., J. M. D. Meiklejohn (The Electronic Classics Series, 1781), 54.

basis for natural philosophy, the crude materialism of the older physicists."[102] Later, he stated that "…science is in reality a classification and analysis of the contents of the mind…"[103] Regrettably, the idealist view of science continues to be propagated by some scholars. The contemporary French physicist, Bernard d'Espagnat, confusing the Copenhagen *interpretation* of quantum mechanics with the equations themselves and disregarding the foundations of the philosophy of science, wrote in 1979: "The doctrine that the world is made up of objects whose existence is independent of human consciousness turns out to be in conflict with quantum mechanics and with facts established by experiment."[104] In a 2007 article for *The Guardian* he advanced the slogan: "What we call 'reality' is just a state of mind."[105] It would be interesting to ask d'Espagnat how he can be so certain of his uncertainty of the existence of the world outside the mind. More fundamentally, how does he know that he cannot know of its existence?

It is perhaps self-evident that both transcendental and subjective idealism are inimical to any investigation of creation, whether theological or empirical. Inquiry into the fundamental structure of matter and energy or space and time seems like a meaningless mental exercise if one accepts the claims of idealism. Similarly, the significance of the saving words and deeds of the Lord Jesus in salvation history become unintelligible in the mental acrobatics that the idealist employs to distrust or deny the objective world outside of the mind of the idealist.

[102] Karl Pearson, *The Grammar of Science* (London: A. and C. Black, 1900), vii.
[103] Ibid., 52.
[104] Bernard d'Espagnat, "The Quantum Theory and Reality," *Scientific American* November, (1979): 158.
[105] Bernard d'Espagnat, "Quantum Weirdness: What We Call 'Reality' Is Just a State of Mind," *The Guardian*, March 20 2009, http://www.theguardian.com/science/blog/2009/mar/17/templeton-quantum-entanglement (accessed 16 December 2013).

Intelligent Design

A third challenge to the theory and practice of natural science as well as Christian faith comes from Christians themselves, specifically those that advance a form of "intelligent design." Intelligent design is a moderated form of creationism – a diffuse movement that emerged in the early twentieth century that rejected *per se* the scientific theory of evolution and asserted a fundamentalist interpretation of the Book of Genesis. The most fundamentalist form of creationism is usually referred to as "Young Earth Creationism." Young Earth Creationists follow the general approach of Archbishop Ussher and posit that the planet is between 5,700 and 10,000 years old.[106] "Old Earth Creationists" are sometimes referred to as "progressive Creationists" as they accept the geological age of the Earth and acknowledge micro-evolution (small evolutionary changes, e.g. changes in gene frequencies in a population). Old Earth Creationists still reject macro-evolution (e.g. speciation).

Members of the intelligent design community typically accept the scientific estimates of the age of the universe (~14 billion years old) and the Earth (~4.5 billion years old), and the fact of micro-evolution. However, intelligent design attempts to confront the unsubstantiated assumption of some Darwinists that evolution is *primarily* driven by an undirected process such as random genetic mutation or natural selection, and therefore suggest direct, divine interventions at certain moments in the evolutionary process. Intelligent design advocates suggest that certain structures (e.g. the human eye) and systems (e.g. the human immune system) are too sophisticated to emerge by a random process. The contemporary American biochemist, Michael Behe, coined the phrase "irreducible complexity" to describe this phenomenon.[107]

During this decade the American evangelical mathematician, philosopher, and theologian, William Dembski, began to describe a "specified complexity" in this theory of

[106] Ronald L. Numbers, *The Creationists: From Scientific Creationism to Intelligent Design* (Cambridge: Harvard University Press, 2006), 11.
[107] Michael Behe, *Darwin's Black Box* (New York: Free Press, 1996).

intelligent design. An entity that exhibits specified complexity is both "complex" and "specified." According to Dembski, specified complexity cannot emerge from a natural process; it must have a designer: "A single letter of the alphabet is specified without being complex. A long sentence of random letters is complex without being specified. A Shakespearean sonnet is both complex and specified."[108]

In both specified complexity and irreducible complexity, a "god of the gaps" argument is presented: Existing scientific theories are unable to explain an aspect of the natural world so a direct intervention by God is invoked to explain the phenomenon. This approach is inconsistent with the Galilean method which presupposes a methodological naturalism, i.e. that all natural phenomena must be explained and verified by reference to natural causes. The Galilean method restricts itself to natural explanations without assuming the existence or non-existence of metaphysical realities such as God. It cannot be identified with "metaphysical naturalism" which denies the existence of the supernatural.

Fundamentally, intelligent design is an inadequate approach to the problem of reconciling God's sovereignty over creation and the success of the methodological naturalism that has demonstrated extraordinary success in discovering the laws of nature. By not adhering to the scientific method, it suggests that certain *natural* phenomena are beyond the scope of *natural* science. Intelligent design can be harmful to Christian faith because once a "gap" is filled by a natural explanation, the "god" that filled the gap may no longer be necessary in the eyes of a believer who suffer from an immature faith. The Christian God is so much greater than any explanation to supplement partial physical and biological theories.

A remedy to the drawbacks of creationism in general, and intelligent design in particular, is the approach of "theistic evolution" rooted in Thomistic philosophy. A leader of this school is American evangelical physician-geneticist, Francis Collins, who acknowledges

[108] William A. Dembski, *Intelligent Design: The Bridge between Science and Theology* (Downer's Grove, IL: InterVarsity Press, 1999), 47.

the fact of biological evolution and also the fact that like all of creation, it was set in motion by God. The macroevolution of hominids is not a problem in theistic evolution. From an ontological perspective, that which primarily separates a human being from an animal is the immortal soul directly imputed by God. In the course of macroevolution, the imposition of an immortal, human soul by God into a hominid satisfies the theological requirements of Genesis and also does not conflict with the general Neo-Darwinian synthesis.

The causality implicit in the act of creation is well treated by Thomistic metaphysics. A truly Catholic view of divine causality in creation clearly avoids the possibility of a "god of the gaps solution" or any tendency toward fundamentalism. Unlike His creatures, the Creator creates without requiring any time; God creates eternally. The contemporary American philosopher, Michael W. Tkacz, succinctly presents this truth: "Creation is not a process with a beginning, a middle, and an end. It is simply a reality: the reality of the complete dependence of the universe on God's agency."[109]

Professor Tkacz also concisely highlights the fundamental distinctiveness of Divine action:

1. God's productive causality is unlike that of any natural cause, for God not only produces what he produces all at once without any process, but also without requiring anything pre-existing or any preconditions whatsoever.
2. God does not act as part of a process, nor does God initiate a process where there was none before.
3. There is no before for God; there is no pre-existing state from which God's action proceeds. God is totally and immediately present as cause to any and all processes.
4. God does not act on nature the way a human being might act on an artifact to change it. Rather, God causes natural beings to be in such a way that they work the way they do.[110]

When the *alterità* (otherness) of Divine power is properly acknowledged, then the limits that man places on God's work of creation are seen for what they are: human misunderstandings.

[109] Michael W. Tkacz, "Aquinas Vs. Intelligent Design," *This Rock* 19, no. 9 (2008): http://www.catholic.com/magazine/articles/aquinas-vs-intelligent-design (accessed 16 December 2013).
[110] Ibid.

III. THE THEOLOGY OF CREATION AND THE NATURAL SCIENCES IN DIALOGUE

A. Essential Elements of Contemporary Physical Cosmology

In order to illustrate the compatibility of the Catholic theology of creation with the natural sciences, it would be helpful to show not only how they emerged harmoniously together, but also how there continues to be no conflict between the tenets of either discipline. Given its scope, contemporary physical cosmology is an ideal discipline to consider in relation to the theology of creation. The leading physical theory and associated cosmological model originated in the early twentieth century with the aforementioned Belgian priest, the Reverend Monsignor Georges Lemaître.

Lemaître, an accomplished mathematical physicist, challenged the prevailing view of his colleagues, such as Albert Einstein, who promoted a static, eternal model of the universe. Monsignor Lemaître's model was novel in that it described a dynamic universe with a beginning. Lemaître describes the basis for his theory in this way:

> We must have a fireworks theory of evolution. The fireworks are over and just the smoke is left. Cosmology must try to picture the splendor of the fireworks. If the Earth were a hundred billion years old, or if the universe were that old, all the nebulae would be out of range of our telescopes and all the radium would be exhausted…The universe is a great number of energy packets that continuously divided themselves. Go back to it all and energy must have existed in one packet…We know that the volume of space is increasing. We know a type of evolution that gives a zero radius…But we must go even beyond that. That takes us to inter-nebular space, where we should expect to find the story of the primeval fireworks that preceded the formation of the expanding universe. In that library of inter-nebular space, we find the story, the characters of which are the writings of cosmic rays…Cosmic rays are the birth cries of the universe still lingering with us.[111]

In a Big Bang cosmology, as time moves forward, the universe expands, temperature drops, density decreases, asymmetry increases, and stability increases. Lemaître's famous differential equation for cosmic expansion is:

[111] Hubert Vecchierello, *Einstein and Relativity; Lemaitre and the Expanding Universe* (Paterson: St. Anthony Guild Press, 1934), 19-22.

$$\dot{R}^2 = \frac{C}{R} + \frac{1}{3}\Lambda R^2 - k$$

where R is the scale factor for cosmic expansion which is proportional to the radius of the universe when that radius has meaning; $C > 0$ and proportional to the average present-day density of non-relativistic matter in the universe; cosmological constant, $-\infty < \Lambda < \infty$, which serves to create a cosmic repulsion that keeps galaxies from being drawn together by gravity when it is positive and adds to the attractive force of gravity when it is negative; and spatial curvature, $k = -1, 0, +1$. Lemaître solved the equation for $k = +1$ and $\Lambda > \Lambda_C$ to describe a big bang model. The significance of these assumptions is that Λ is greater than the critical value of the cosmological constant, Λ_C, so the universe expands forever. Also, $k = +1$ implies a spherical geometry and a closed, finite universe ($k = 0$ is a flat, unbounded, and infinite universe while $k = -1$ is a saddle shaped, open, unbounded, and infinite universe). Modern observation indicates that the curvature is very near zero. However, the intrinsically inaccurate nature of measurement means that we may never know if the universe is actually flat, spherical, or saddle shaped.[112]

Our present knowledge of physical cosmology is the fruit of observational data, our knowledge of the laws of physics, and the application of mathematical techniques such as Einstein's field equations and simulation modeling. A key assumption is that the current laws of physics were valid at the earliest moments of the universe, notwithstanding the fact that our present models cannot probe deeper than before 10^{-43} seconds, i.e. the Planck epoch. During the Planck epoch, it is very likely that the quantum effects of gravity were substantial and because there is no unified theory of quantum gravity, the physics of the Planck epoch are uncertain. Inquiry into distances shorter than one Planck length, the distance light travels in one Planck time, 1.616×10^{-35} meters, is similarly uncertain.[113]

[112] Ray D'Inverno, *Introducing Einstein's Relativity* (Oxford: Clarendon Press, 1992), 331-341.
[113] Edward W. Kolb and Michael S. Turner, *The Early Universe* (New York: Basic Books, 1994), 447.

Shortly after Lemaître's groundbreaking 1927 paper was published, observational data emerged that strongly confirmed his primeval atom hypothesis. The American astronomer, Edwin Hubble (1889 – 1953), observed the recession of galaxies and noted that cosmic expansion was well governed by the laws of general relativity. Hubble's continued research of extra-galactic evolution led him to realize that galaxies were moving away from the Earth at velocities directly proportional to their distance, now known as Hubble's Law.[114] All of these observations were consistent with Lemaître's hypothesis.

It should be noted that in the 1920s, Albert Einstein's model of the universe included a cosmological constant which permitted a static, finite universe, closed, but not bounded. The Dutch mathematician, Willem de Sitter (1872 – 1934), developed a mathematically interesting model that involved expansion, but did not match Hubble's observations. It was also physically impossible because it implied that the universe had zero density for matter everywhere. Independently of Monsignor Georges Lemaître, the Soviet mathematician and meteorologist, Alexander Friedman (1888 – 1925), described a dynamic model by taking particular solutions to Einstein's equations which defined a spatially homogeneous, isotropic universe with a finite radius varying with time.[115] For this reason, the standard model of contemporary cosmology is sometimes called the Friedmann–Lemaître Model.

After Hubble's Law, the development of a realistic estimate for the relative abundance of fundamental elements in the universe turned out to be the second major confirmation of the Big Bang hypothesis. It was found that the universe was composed of ~72% hydrogen, ~25% helium, and ~3% other elements. In 1948, the Russian-American physicist, George Gamow (1904 – 1968), and his doctoral student, Ralph Alpher (1921 – 2007), published a paper proposing a theory of nucleocosmogenesis, i.e. a process by which

[114] Edwin Hubble, "A Relation between Distance and Radial Velocity among Extra-Galactic Nebulae," *Proceedings of the National Academy of Sciences* 15, (1929): 168-173.
[115] Paul A.M. Dirac, *The Scientific Work of Georges Lemaitre*, vol. 36 (Vatican: Pontificia Academia Scientiarvm, 1968), 6.

atomic nuclei were created from pre-existing nucleons.[116] This theory, now often referred to as Big Bang nucleosynthesis, explained the initial formation and current abundance of hydrogen and helium (with their respective isotopes) in the universe. According to Big Bang nucleosynthesis, in three minutes, the universe was "cooked", i.e. the low mass nuclei were created. Gamow's hypothesis also accounted for the hydrogen and helium that serve as fuel for stars that give birth to larger elements through stellar nucleosynthesis.[117]

The discovery of the cosmic microwave background radiation (CMBR) in 1965 was the third major confirmation of Lemaître's hypothesis. Remarkably, Arno A. Penzias and Robert W. Wilson discovered the CMBR completely by accident. Employed by Bell Labs in Holmdel, New Jersey, the two physicists were building a receiver for use in radio astronomy. When it was completed, they immediately detected an unexpected, low power, isotropic radiation source. This radiation presented a thermal black body spectrum at a temperature of ~2.7K (or -454°F).[118] After Penzias and Wilson ruled out white noise from New York City, built-up guano on the antenna, etc., an explanation for the observed excess noise temperature was given by Robert Dicke (1916 – 1997), Jim Peebles, Peter G. Roll, and David T. Wilkinson (1935 – 2002): background radiation from the Big Bang.[119]

According to Big Bang theory, for the first few thousand years, matter and energy were continuously being converted. Later, as matter and energy began to separate, differences in the matter-energy density was speculated to account for the creation of galaxies and the emergence of inter-galactic structure.[120] The echoes of theses density gradients were detected by the COsmic Background Explorer (COBE) satellite in 1992 as a faint anisotropy in the cosmic background radiation which otherwise was a near-perfect black-body spectrum.

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[116] Ralph A. Alpher, Hans Bethe, and George Gamow, "The Origin of Chemical Elements," *Physical Review* 73, no. 7: 803-804.
[117] Haffner, *Creazione E Creatività Scientifica*, 209.
[118] Arnold Penzias and Robert Wilson, "A Measurement of Excess Antenna Temperature at 4080 Mc/S," *Astrophysical Journal* 142, no. 7 (1965): 419-421.
[119] Robert Dicke et al., "Cosmic Black-Body Radiation," *Astrophysical Journal* 142, no. 7 (1965): 414-419.
[120] Haffner, *Creazione E Creatività Scientifica*, 213.

Launched on November 18, 1989 aboard a Delta 5000 rocket, this NASA satellite developed at the Goddard Space Flight Center provided a fourth key confirmation of Big Bang theory.[121] As a result of their significant contribution to cosmology, the 2006 Nobel Prize in Physics was jointly awarded to John C. Mather and George F. Smoot "for their discovery of the blackbody form and anisotropy of the cosmic microwave background radiation."[122]

A fifth major confirmation of Lemaître's general theory was announced on March 17, 2014. In what may be a Nobel Prize-winning discovery, a team of astronomers revealed the detection of the effects of the primordial inflationary gravitational waves in the B-mode power spectrum of the CMBR. It is believed that these gravitational waves played a decisive role in the formation of the very early universe. Without an inflationary hypothesis in Big Bang cosmology, it is unclear why the universe is statistically homogeneous and isotropic. For example, two exceedingly distant regions of the observable universe could not have equilibrated, as has been observed, because the regions move apart faster than the speed of light. [123]

In 1979, the American physicist, Alan Guth, provided a solution with cosmic inflation theory that is colloquially called the "bang" in the "Big Bang." According to Guth, as a result of the very high energies present in the earliest moments of the universe, there would have existed forms of matter that create *repulsive* gravity. Guth hypothesized that less than a trillionth of a second after the Big Bang, the universe would have expanded faster than the speed of light as a result of negative vacuum pressure coming from the repulsive form of gravity. The violent gravitational waves would have compressed space in one direction and

[121] The Royal Swedish Academy of Sciences, *Cosmology and the Cosmic Background Radiation* (3 October 2006). http://www.nobelprize.org/nobel_prizes/physics/laureates/2006/advanced-physicsprize2006.pdf (accessed 24 January 2013).
[122] The Royal Swedish Academy of Sciences, *The Nobel Prize in Physics 2006*, http://www.nobelprize.org/nobel_prizes/physics/laureates/2006/ (accessed 24 January 2013).
[123] Dennis Overbye, "Space Ripples Reveal Big Bang's Smoking Gun," *The New York Times*, (17 March 2014): http://www.nytimes.com/2014/03/18/science/space/detection-of-waves-in-space-buttresses-landmark-theory-of-big-bang.html?_r=0 (accessed 20 March 2014).

expanded it in another, producing the observable "twists" or "ripples" in the expanding energy field. This phenomenon ultimately played a critical role in generating the large-scale structures of the cosmos.[124] Hubble's Law, Big Bang nucleosynthesis, the detection of the CMBR, the discovery of the blackbody form and anisotropy of the CMBR, and now the detection of the B-mode polarization of the CMBR confirm and develop the fundamental theory of physical cosmology proposed by Monsignor Georges Lemaître.

B. Reflections on Biblical Cosmology in the Thought of Benedict XVI

An appropriate starting point for a study of Biblical cosmology is to distinguish the *physical* cosmology of the ancient Israelites from the *metaphysical*. Like some of the other cultures of the ancient Middle East, the Israelites believed in a three-tiered cosmology in which the Earth was a flat disc that floated over the waters. The heavens where God dwelled were naturally "over" the Earth and the subterranean world "below" was the place of death, *sheol*.[125] Obviously, twenty-first century Christians do not accept the ancient Israelite physical cosmology. But that does not mean that there are not significant theological insights in the metaphysical Biblical cosmology. Therefore, the Christian must distinguish with prudence the physical elements and the metaphysical elements in the Sacred Scriptures because God inspired the spiritual truths expressed in the Biblical cosmology for the sake of man's salvation. While the sacred writers presumed the physical cosmology of their era, their primary intention was not to communicate this cosmology, but rather metaphysical, i.e. spiritual, truths.[126]

In the first book of the Bible, Genesis, one reads the story of the creation of the world. This story teaches many important lessons about God, His creation, and in particular His

[124] Ibid.
[125] David E. Aune, *The Westminster Dictionary of New Testament and Early Christian Literature and Rhetoric* (London: Westminster John Knox Press, 2003), 118-119.
[126] It would be unreasonable to expect that the sacred writers would have a knowledge of twentieth century physical cosmology. This however does not imply that the Bible contains error. Rather, their description of the natural world was the result of their simple observation of the world around them, unaided by contemporary instrumentation and theory.

creation *par excellence*, man. For this reason, the Church believes that the Book of Genesis does not purport to refute the aforementioned astronomical insights of the twentieth century. The quest for ultimate metaphysical meaning can only be satisfied when one personally encounters the God of infinite *agape* while the quest for scientific truth is satisfied when one understands the physical origins, evolution, structure, and destiny – *logos* – of the material universe. The Christian does not exclude either of these quests from his life because as St. Augustine famously said: "All truth is God's truth."[127]

The rationality of creation continues to be a source of marvel for all who contemplate its structure, complexity, and beauty. Even a physicist of such ambiguous religious belief as Albert Einstein once remarked that in the laws of nature "there is revealed such a superior Reason that everything significant which has arisen out of human thought and arrangement is, in comparison with it, the merest empty reflection."[128] At an exceedingly authentic human level, every person yearns for transcendence from their finite, temporal existence. When one contemplates the beauty of nature, from the structure of a single cell, to the immensity of the world's oceans, to the seemingly boundless limits of space, the human mind is lifted up from the postmodern malaise that no longer seeks the Infinite.

Pope Benedict XVI reminds us that contrary to the atheist narrative, "the universe is not the product of darkness and unreason. It comes from intelligence, freedom, and from the beauty that is identical with love."[129] While agnostic and atheist scholars may try to deconstruct and marginalize the meaning of the Biblical accounts of creation through the application of social praxis, history, literary criticism, linguistic analysis, or aesthetics, the significance of the symbolic elements in the text is enduring.

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[127] Common English paraphrase from St. Augustine, *De Doctrina Christiana* (397), II, 75.
[128] Albert Einstein, *Mein Weltbild*, ed. Karl Seelig (Vienna: Europa-Verl, 1953), 21. Translation by Boniface Ramsey, O.P. found in *In the Beginning* by Joseph Cardinal Ratzinger.
[129] Joseph Ratzinger, *In the Beginning…: A Catholic Understanding of the Story of Creation and the Fall*, trans., Boniface Ramsey (Grand Rapids: Wm. B. Eerdmans Publishing Company, 1995), 25.

It is important to acknowledge that the Biblical narratives of creation do not communicate in the same way as modern prose. Rather, they communicate their timeless truths through stories, metaphors, and Jewish numerology. Through these devices, the Bible tells the reader that God is One, that God is good, and that God created the world out of love. They express the nature of creation, the extraordinary dignity of the human person in creation, and man's sacred dominion over the land, air, water, plants, and animals. Finally, as Benedict points out, the Scriptures convey the abiding truth that "creation is oriented to the Sabbath, which is the sign of the covenant between God and humankind."[130]

The universe was created to give glory to God and although He has no need of man's worship, it is man's greatest act. In particular, Sabbath worship is supremely pleasing to the Lord. Pope Benedict XVI highlights that in the Biblical stories of creation, the Sabbath is revealed as the day when man, "in the freedom of worship, participates in God's freedom, in God's rest, and thus in God's peace. To celebrate the Sabbath means to celebrate the covenant. It means to return to the source and to sweep away all the defilement that our work has brought with it."[131] He goes on to point out how the Mosaic Law's precept of observing the Sabbath is linked with this notion of authentic human flourishing and freedom. Not only does every seventh day bring about universal equality among God's people, but every seventh year is also offered so that the land and the people may rest. Every seven times seven Sabbath year was to be a Great Sabbath in which "all debts are remitted and all purchases and sales annulled."[132] Unfortunately, the new life and rebirth for both the land and its people that were offered by this precept were not realized as the Israelites apparently never carried it out.

The Biblical theology of creation also answers questions about who man is. In Genesis 2:7 (RSV), it states that "the Lord God formed man of dust from the ground, and

[130] Ibid., 27.
[131] Ibid., 30-31.
[132] Ibid., 31.

breathed into his nostrils the breath of life; and man became a living soul." Pope Benedict XVI describes this fact as both "humbling and consoling."[133] It diffuses any temptations for men to believe that they are gods as it clearly reveals their temporal, limited, and created nature. The awareness, often painful, of human mortality can be a healthy reminder that "you are dust, and to dust you shall return."[134] Only God is eternal *ipsum esse subsistens*. The Book of Genesis also reminds humanity that despite the evil of which man is capable, he was "fashioned from God's good Earth,"[135] in God's image and likeness.[136] Man was not created by Satan and despite his occasional cooperation with the Murder-Accuser-Liar, man's supernatural end is eternal communion with his Creator, made possible after the Fall by the atoning sacrifice of Christ.

The story of creation in Genesis also inspires an acknowledgment of the divinely instituted brotherhood of man. As descendants of the first man, Adam, every man is a part of the one family of humanity. Notwithstanding the differences in physical appearance, language, culture, and even religion, all men share the same origin and are called to the same end. Benedict is very strong in his rebuke of any assertion of different categories of human persons with varying degrees of value: "We are all from only *one* Earth. There are not different kinds of 'blood and soil,' to use a Nazi slogan."[137] The Scriptures are clear: human division, e.g. racism, comes not from God but from the Evil One.

It is very striking to consider that in all of creation, it is only in man that God offers a share of his very Spirit, the "breath of life"[138] itself. The Earth, Moon, and stars are not an emanation from God in a pantheistic way. The animals and plants are not recipients of an immortal soul. It is only to Adam and Eve that a share in the Divine life is given. Therefore

[133] Ibid., 42.
[134] Genesis 3:19 (RSV)
[135] Ratzinger, 43.
[136] cf. Genesis 1:26
[137] Ratzinger.
[138] Genesis 2:7 (RSV)

it is no surprise that God commands man: "Thou shall not kill." Every human person has a soul that is created directly by God and therefore his dignity far surpasses all the rest of creation. It is for this reason that the Church proclaims the dignity of all human life from the moment of conception until death. Pope Benedict reminds his congregation that no illness, disfigurement, handicap, or decision by another can ever diminish the God-given value of a human being.[139]

C. The Logos of Faith and Science in the Thought of Benedict XVI

The contributions of Pope Benedict XVI to the compatibility of the theology of creation and the natural sciences is established upon a very fundamental insight: the primacy of the *Logos* Himself – Jesus, the Eternal Son of the Father – who is the source of all rationality, meaning, and purpose in the universe. During his Apostolic Journey to München, Altötting, and Regensburg in 2006, he was invited to address the scientific community of the University of Regesnburg in the *aula magna*. The Pope's lecture was entitled "Glaube, Vernunft und Universität — Erinnerungen und Reflexionen" (Faith, Reason, and the University — Memories and Reflections) and further elaborated his thought on the centrality of the *Logos*.

The intelligibility of nature, and indeed of divine revelation itself, rests on man's ability to share in the *logos* in creation. Benedict points out that while the Church has always taught that there is an infinite gap between the eternal wisdom of the "Creator Spirit and our created reason, there exists a real analogy, in which – as the Fourth Lateran Council in 1215 stated – unlikeness remains infinitely greater than likeness, yet not to the point of abolishing analogy and its language."[140] Rejecting a theology of God that he characterizes as "sheer, impenetrable voluntarism," the Holy Father reminds his audience that "rather, the truly divine

[139] Ratzinger, 45.
[140] Benedict XVI, "Faith, Reason, and the University — Memories and Reflections," in *The Regensburg Lecture*, ed. James V. Schall(South Bend, IN: St. Augustine's Press, 2006), #27.

God is the God who has revealed Himself as *logos* and, as *logos*, has acted and continues to act lovingly on our behalf."[141]

Openness to the full breadth of *logos* provides for the appropriate autonomy and status of philosophy, theology, history, mathematics, physical science, and biological science; it has always been a hallmark of the Catholic intellectual tradition. Aware of assaults on the status of some of these *scientiæ*, Pope Benedict criticized the approach of those who believe that "scientific certainty" is the only legitimate form of knowledge and that it can only be found as a result of analyses based on "the interplay of mathematical and empirical elements."[142] After all, the English word "science" comes from the Latin *scientiæ* that derives from *sciens*, the present participle of *scio*, meaning "I know or understand." When the "radius of science and reason"[143] is reduced, the question of God and His work in creation becomes, by definition, un-scientific, un-knowable, and not able to be understood, i.e. unreasonable.

In this fragmented form of reason, deeply human questions such as the origin and destiny of man and those handled by religion and ethics "have no place within the purview of collective reason as defined by 'science,' so understood, and must thus be relegated to the realm of the subjective."[144] This is a devastating shortcoming and the hallmark of modernism. Pope Benedict succinctly points out that "the subject then decides, on the basis of his *experiences*, what he considers tenable in matters of religion, and the subjective 'conscience' becomes the sole arbiter of what is ethical."[145] (emphasis added) When theological and particularly moral questions become completely personal matters, religion and ethics are placed outside of the scope of reason and as the history of the twentieth century makes very

[141] Ibid.
[142] Ibid., #45.
[143] Ibid., #46.
[144] Ibid., #48.
[145] Ibid.

clear, "disturbing pathologies of religion and reason…necessarily erupt."[146] Benedict reminds his audience that the modern and postmodern tendencies to attempt to create an ethical system based on the principles of biological evolution, psychology, or sociology, are always grossly lacking.

One of the causes of the movement to reduce reason comes from the challenge of cultural pluralism. This threat comes both *ab extra* and *ab intra*, e.g. the influence of Hellenism in Catholic thought has been questioned even by Catholic theologians, such as the Reverend Hans Küng. These theologians would try to create some "pure" version of the New Testament message, not "infected" by Hellenistic culture, to preach not only in the West but also in mission territories. Pope Benedict firmly rebukes this approach, stating: "This thesis is not simply false, but it is coarse and lacking in precision. The New Testament was written in Greek and bears the imprint of the Greek spirit, which has already come to maturity as the Old Testament developed."[147] For this reason, "the fundamental decisions made [by the early, Greek-speaking Church] about the relationship between faith and the use of human reason are part of the faith itself; they are developments consonant with the nature of faith itself."[148]

The rejection of Aristotelian (Greek) metaphysics and the intelligibility that it provides the other sciences did not appear for the first time in the twentieth century. The movement of Martin Luther (1483 –1546) toward a *sola Scriptura* theology was partially rooted in an attempt to remove what he considered to be the "alien" presence of philosophy in theology. Three hundred years later Immanuel Kant suggested that faith needed to be "protected" from the reason of metaphysics. In other words, the Church "needed to set thinking aside in order to make room for faith."[149] It becomes obvious when one adopts this

[146] Ibid., #49.
[147] Ibid., #52.
[148] Ibid., #53.
[149] Ibid., #35.

mindset that any discussion of a Creator and creation is outside the realm of reason and is understood *sola fide*. In his *Critique of Pure Reason*, Kant introduced the modern self-limitation of reason. Additionally, given the overwhelming success of the empirical method in empirical science, Kant's reduced form of reason was further radicalized yielding what Benedict calls "a synthesis between Platonism (Cartesianism) and empiricism, a synthesis confirmed by the success of technology."[150]

The Pope does not retreat into fundamentalism to respond to the challenges of modernity. Rather, he seeks to identify the positive features and retain them, e.g. modernity "presupposes the mathematical structure of matter, its intrinsic rationality, which makes it possible to understand how matter works and use it efficiently: this basic premise is…the Platonic element in the modern understanding of nature."[151] Furthermore, the Holy Father emphasized how modern scientific reason "points beyond itself."[152] In his Verona address of October 19, 2006, Pope Benedict returned to this topic:

> Mathematics as such is a creation of our intelligence: the correspondence between its structures and the real structures of the universe – which is the premise for all the modern scientific and technological developments, already formulated explicitly by Galileo Galilei with the famous assertion that the book of nature is written in mathematical language – arouses our admiration and raises a great question. It implies, in fact, that the universe itself is structured in an intelligent manner, in such a way that there exists a profound correspondence between our subjective reason and reason as objectified in nature. So it becomes inevitable to ask *if there must not exist a single originating intelligence, which would be the common source of both the one and the other*.[153] (emphasis added)

This approach respects the autonomy and ends of the formal and natural sciences while acknowledging that they do not and cannot exhaustively describe reality.

It is a marvelous claim of the Christian religion that the human intellect is capable of knowing (albeit imperfectly) God, His will, and His work in creation. Furthermore, His invitation to a loving relationship is a distinctive feature of the God of the Scriptures. At

[150] Ibid., #40.
[151] Ibid., #41.
[152] Ibid., #59.
[153] Benedict XVI, "Address of the Holy Father to the Convegno Nazionale Della Chiesa in Italia," (2006): , http://www.vatican.va/holy_father/benedict_xvi/speeches/2006/october/documents/hf_ben-xvi_spe_20061019_convegno-verona_en.html (accessed 7 February 2014).

Regensburg, Pope Benedict reflected on the significance of man's relationship with the Divine *Logos*: "God does not become more divine when we push him away from us in a sheer, impenetrable voluntarism; rather, the truly divine God is the God who has revealed himself as *logos* and, as *logos*, has acted and continues to act lovingly on our behalf."[154] Perhaps one could summarize Pope Benedict's insight here as "Deus est ratio (*logos*) et Deus est caritas (*agape*)."[155] This wise approach orients one to avoid the perennial difficulties in theology of overemphasizing God's transcendence (e.g. as found in Islam) or His immanence (e.g. as found in twentieth century Modernism).

Regrettably, these contributions and indeed the fundamental invitation to "engage the whole breadth of reason" in the contemporary university were lost on many as a result of the media's emphasis on the Islamist reaction to the address. At Regensburg, Pope Benedict made reference to a dialogue that occurred very likely during the winter of 1391 between the erudite Byzantine Emperor, Manuel II Paleologus, and an educated Persian on the subject of Christianity and Islam, and the truth of both. In the course of this exchange, the Emperor stated: "Show me just what Mohammed brought that was new, and there you will find things only evil and inhuman, such as his command to spread by the sword the faith he preached."[156] He then went on to explicate in detail the irrationality of spreading religion by the sword. Pope Benedict beautifully summarized it stating: "Violence is incompatible with the nature of God and the nature of the soul."[157]

The Emperor went on to state:

> God…is not pleased by blood – and not acting reasonably (σὺν λόγω) is contrary to God's nature. Faith is born of the soul, not the body. Whoever would lead someone to faith needs the ability to speak well and to reason properly, without violence and threats…To convince a

[154] Benedict XVI, "Faith, Reason, and the University — Memories and Reflections," #27.
[155] James V. Schall, *The Regensburg Lecture* (South Bend: St. Augustine's Press, 2007), 123.
[156] Emperor Manuel II Paleologus cited in Benedict XVI, "Faith, Reason, and the University — Memories and Reflections," #12.
[157] Ibid., #13.

> reasonable soul, one does not need a strong arm, or weapons of any kind, or any other means of threatening a person with death…[158]

Commenting on this fact, Pope Benedict recognized that because of the Emperor's Christian intellectual formation, it was self-evident for him to believe that to act unreasonably is contrary to God's nature. However, this presupposition was not held by the Persian because according to "…Muslim teaching, God is absolutely transcendent. His will is not bound up with any of our categories, even that of rationality."[159] The consequences of this error for theology are devastating. Benedict gave the example of the highly respected eleventh century Muslim intellectual, Ibn Hazm, who "went so far as to state that God is not bound even by his own word, and that nothing would oblige him to reveal the truth to us. Were it God's will, we would even have to practice idolatry."[160]

Reporting on the reaction to the Pope's address in the Islamic world, the *Wall Street Journal* editorial board entitled its piece: "Benedict the Brave." Although it was clearly not his intent, the Pope certainly "hit a nerve" as various terrorist organizations in Iraqi called for attacks on the Vatican City State. In Somalia, a Muslim cleric with connections to the ruling Islamist party called on Muslims to "hunt down" and murder the Holy Father. While in Pakistan, the legislature unanimously passed a resolution condemning the Pope and demanding an apology.[161] In essence, all of these responses from the Muslim world proved a point made by Benedict that intercultural dialogue is not possible if reason (*logos*) is excluded from the exchange.

Pope Benedict concluded his Regensburg address stating that "it is to this great *logos*, to this breadth of reason, that we invite our partners in the dialogue of cultures. To rediscover

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[158] Ibid.
[159] Ibid., #14.
[160] Ibid., #15.
[161] "Benedict the Brave," *The Wall Street Journal*, 19 September 2006, http://online.wsj.com/news/articles/SB115862615497066989 (accessed 20 February 2014).

it constantly is the great task of the university."[162] Benedict would certainly acknowledge however that it is unlikely that the intellectual problems of scientism and reductionism will be surmounted *solely* through good philosophical reasoning. In the Academy, there is often a "wall of ideology" that can only be broken down when, as Lancellotti says, "the human heart…[is]…'wounded'…by the beauty of the cosmos, which endlessly calls reason not to close upon itself but to open itself up to the infinite mystery of being."[163] This is the openness to which Pope Benedict invited the world at Regensburg: a stance of "wonder in front of Being in all its dimensions."[164] In a very "Benedictine" way, emphasizing Christ's presence as *logos* and *agape*, Lancellotti suggests a path forward for redeeming reason through the Gospel:

> …it has been the Christian experience that this "redemption" of reason can only happen as a fruit of the encounter with the beauty of Christ. Only the dramatic encounter with the Word incarnate can bring reason back to its truth: that its being is "to be touched by Being," just like the faculty of sight finds its being in being struck by light.[165]

D. Benedict the Thomist

It is well-established that the Reverend Professor Joseph Ratzinger began his academic career firmly as an Augustinian, having written his doctoral dissertation on St. Augustine: *Volk und Haus Gottes in Augustins Lehre von der Kirche* (The People and the House of God in Augustine's Doctrine of the Church). Nonetheless, it is interesting to note the strong Thomistic aspects of the thought of the later Cardinal Ratzinger and Pope Benedict XVI. In particular, one sees a high level of concord between the renewed Thomism of the Albertus Magnus Lyceum for Natural Sciences[166] and the thought of the Pope Emeritus.

In 2010, Pope Benedict XVI dedicated three Wednesday audiences (on June 2, 16, and 23) to the contributions of St. Thomas Aquinas. While certainly aware of the weaknesses

[162] Benedict XVI, "Faith, Reason, and the University — Memories and Reflections," #16.
[163] Lancellotti, 6-7.
[164] Ibid., 7.
[165] Ibid.
[166] Based in River Forest, Illinois, USA.

of the twentieth century conceptual Thomism to which he was exposed in his seminary education, Benedict is also cognizant of the enduring contributions of Thomas and the need for the Church to look to him as a touchstone in Catholic thought. In particular, in the June 16 address, he commented on Thomas' contribution to the dialogue between faith and reason:

> …In the nineteenth century, when the incompatibility of modern reason and faith was strongly declared, Pope Leo XIII pointed to St. Thomas as a guide in the dialogue between them. In his theological work, St. Thomas supposes and concretizes this relationality. Faith consolidates, integrates, and illumines the heritage of truth that human reason acquires. The trust with which St. Thomas endows these two instruments of knowledge faith and reason may be traced back to the conviction that both stem from the one source of all truth, the divine *Logos*, which is active in both contexts, that of Creation and that of redemption.[167]

For Benedict, the gift of the *logos* for the human soul enables man to acknowledge and appreciate the intelligibility of creation. It also permits man to acknowledge that God is the creator of all things, visible and invisible, and therefore all creation is governed by order and reason. As a consequence, the human intellect can study and understand the natural world by acknowledging the mathematical structure of reality, applying quantitative methods to model the natural world, formulating a hypothesis based on the model, testing the hypothesis through experimentation, and revising the hypothesis based on the results of the experiments to define a theory. But the Christian does not remain at this level of reason; he also looks beyond physics, i.e. metaphysics. Pope Benedict would say that the mathematical *logos* discovered in the natural sciences always points beyond itself to "Another."

According to Benedict, the metaphysical approach of St. Thomas Aquinas is an important instrument to preserve the openness of the human intellect to the fullness of reality. In his address of June 16, 2010 he also stated that:

> Thomas presents to us a broad and confident concept of human reason: *broad* because it is not limited to the spaces of the so-called empirical-scientific reason, but open to the whole being…and *confident* because human reason, especially if it accepts the inspirations of Christian faith, is a promoter of a civilization that recognizes the dignity of the person.[168]

[167] Benedict XVI, "General Audience E - Saint Thomas Aquinas (2)," 16 June 2010.
[168] Ibid.

Critics of metaphysics must be reminded that the human intellect is capable of analyzing reality according to different modes of abstraction. The English word "abstraction" comes from the Latin root *abstrahere* – "to pull from" or "to take out." Thus, as Lancellotti, points out: "…in front of any object, reason is capable of 'taking out' certain aspects by applying to experience appropriate 'categorical selections'."[169] In the field of modern physics, the scientist investigates real existing beings, through the use of instrumentation, under one very particular aspect: spatial and temporal extension. As a consequence, he then discovers what Lancellotti calls the "mysterious and beautiful mathematical structures hidden in the physical data, which reveal a deeper order immanent within reality which was not immediately evident to the mind."[170]

In order for the compatibility of the theology of creation and the natural sciences to be clearly evident, a proper ontology is necessary. According to the Reverend Benedict M. Ashley, O.P. (1915 – 2013), since all knowledge is acquired through the senses, it would be logical to establish the natural sciences as epistemologically prior to the others and to establish the validity of a metaphysics on the following conditions:

1. There can be no valid metaphysics formally distinct from natural science unless its subject, Being as Being (*esse*), as it analogically includes both material and immaterial being, has first been validated in a manner proper to the foundations integral to natural science by a demonstration of the existence of immaterial beings as the cause of material beings.
2. Modern natural science can achieve such a demonstration, but only if its own foundations are rendered unequivocally consistent with sense observation by an analysis such as is exemplified by Aristotle's *Physics* as interpreted by Aquinas.[171]

Fundamentally, if a metaphysics of material beings cannot be credibly demonstrated, how can this same metaphysics be used for immaterial creatures, e.g. angels, or to discuss God Himself – *ipsum esse subsistens.*

[169] Lancellotti, 4.
[170] Ibid.
[171] Benedict M. Ashley, *The Way toward Wisdom*, ed. John Deely, Thomistic Studies (Notre Dame, IN: University of Notre Dame Press, 2006), 53.

This interpretation of the method and doctrine of St. Thomas Aquinas, very much in harmony with the thought of Pope Benedict XVI, seeks a positive dialog with the natural sciences. In particular, it is supportive of an integrative approach of *philosophia naturalis* with the foundations of empirical science. While such a metaphysics would be formally distinct from the natural sciences, it is also open to the event of divine revelation. Additionally, it avoids the anthropocentric emphasis of Transcendental Thomism that often makes human self-consciousness the point of departure for metaphysics.

In a lecture at the Pontifical Gregorian University in Rome, the Reverend Paul Haffner points out that regrettably "in the last century, the belief in creation has been reduced mostly to the affirmation that everything that exists is due to Divine causality. There has been a tendency to see the content of the Christian faith as a response to the word of revelation handed down through the history of salvation."[172] This emphasis is strongly expressed in the thought of the Transcendental Thomist, the Reverend Karl Rahner, S.J. and his theological anthropology that understands man primarily as a "hearer of the Word."[173]

Instead of following or further developing the classical Thomistic metaphysics and epistemology, Rahner pursued the existentialism of his teacher, the German philosopher, Martin Heidegger (1889 – 1976). Rahner's 1941 work, *Hearers of the Word*, attempted to reinterpret Thomistic metaphysics from the point of view of Heidegger's phenomenological ontology. By beginning with Heidegger's idea that the question of the meaning of one's being is preceded by a "pre-grasp" of the world's horizon of meaning, Rahner suggested that man's quest for meaning of experience is grounded in a "pre-conceptual" grasp of God's infinite horizon of being. Along with *Spirit in the World*, *Hearers of the Word* manifested the philosophical views that underlie his entire theological system. *Spirit in the World* offers a

[172] Paul Haffner, "Verso Una Teologia Dell' Ambiente," *Lecture at the Pontifical Gregorian University* 4 December 2013.
[173] Karl Rahner, *Hearers of the Word (Hörer Des Wortes: Zur Grundlegung Einer Religionsphilosophie)*, trans., Michael Richards (New York: Herder and Herder, 1969).

general philosophical anthropology while *Hearers of the Word* is deliberately more theological and particularly addresses the question of revelation.[174]

Since the time of the Apostles[175], orthodox Christians have always maintained that "matter matters" and for this reason the Church condemned the teachings of the Docetists who denied the fact of the Incarnation. The Docetists claimed that Jesus only seemed to assume a human nature and that his human form was merely an illusion. In a sense reviving the ideas of these ancient heretics, German idealist philosophers believe that reality, or reality as far as it can be known, is essentially mental and immaterial. Therefore, it is not surprising that the influences of this school have had a detrimental effect on faith by disconnecting theology from its roots in God's tangible work in creation.

[174] Wesley Wildman, "Karl Rahner," *Boston Collaborative Encyclopedia of Western Theology*: http://people.bu.edu/wwildman/bce/rahner.htm (accessed 7 December 2013).
[175] Cf. I John 1:1-3; I John 4:1-3; and 2 John 1:7.

IV. CONCLUSION

A. The Christian Contribution

Coming to a satisfactory understanding of creation is obviously not an easy task. Despite the extraordinary brilliance of the ancient Egyptians, Indians, Chinese, Mesopotamians, Greeks, Pre-Colombian Americans, and Muslims, in the areas of writing, mathematics, architecture, and engineering, contemporary studies in the history of science have shown that these sophisticated cultures never successfully developed an effective method for the study of nature. The polytheistic religious beliefs and pantheistic understanding of the cosmos prevented the magnificent intellects of those civilizations from believing that the universe was guided by *logos*, rather than *mythos*. By appealing to the behavior of capricious gods and goddesses, beset by very human passions for power and pleasure, to explain the natural world, the natural sciences could never be born in the pagan world.

It was not until the revelation of God to the Jewish people and ultimately the incarnation of the eternal *Logos*, Jesus the Christ, that mankind could fully appreciate the great order of the universe. An answer to the question of why there is *something* rather than *nothing* is provided by the revelation that God is both *ratio et caritas*. He created the universe, endowing it with structure and meaning, and ordained that the pinnacle of His creation – man and woman – might enjoy eternal beatitude with Him for no other reason than His great love.

The keen awareness of this fact led the fathers of the Church, the medieval Scholastics, as well as Christians of the modern era to systematically study nature, freed from the shackles of myth and the philosophical errors that restrict human reason. One remarkable expression of this was the formulation of the Big Bang hypothesis by Monsignor Georges Lemaître. The fact that a Catholic priest developed a most promising model of physical

cosmology, confirmed by extensive empirical evidence, is a motive of credibility for the Catholic approach to faith and reason. To quote Blessed John Paul II, for the Catholic Christian: "Faith and reason are like two wings on which the human spirit rises to the contemplation of truth; and God has placed in the human heart a desire to know the truth – in a word, to know Himself – so that, by knowing and loving God, men and women may also come to the fullness of truth about themselves (cf. Ex 33:18; Ps 27:8-9; 63:2-3; Jn 14:8; 1 Jn 3:2)."[176]

In the work of his successor, Pope Benedict XVI, one finds an exceptional articulation of Christian faith, rooted in a total openness to the full capabilities of human reason. This reason respects the mathematical structure of the material universe and the method of natural science, while also appreciating the metaphysical aspects of creation and indeed the Creator Himself. Through his further development of the theology of creation and brilliant dialogue with philosophers and scientists that seek to impose illegitimate restraints on human reason, the intrinsic compatibility of Christian faith with the natural sciences has been made manifestly clearer by Pope Benedict.

B. Persisting Challenges

Nonetheless, obstacles remain that hinder the postmodern, non-believing man from accepting the compatibility of Biblical, metaphysical cosmology with contemporary, physical cosmology. Often, the root of this dismissal comes from a rejection of faith in creation itself. Pope Benedict XVI identifies three forms of concealment of the concept of creation in contemporary thought that contribute to the perceived conflict between science and theology:

1. "Nature" is understood exclusively in the sense of the object of science; any other definition of the word is dismissed as meaningless.
2. Reaction and resentment against technology, which is already noticeable in Rousseau, has long since become a resentment against humans, who are seen as the disease of nature.
3. …Nature is undermined for the sake of grace; it is robbed of its belongings…[177]

[176] John Paul II, *Fides Et Ratio* (1998), Introduction.
[177] Ratzinger, 93-94.

With regard to the first form of concealment, Benedict points out that an inadequate understanding of "nature" has a detrimental effect on moral life and the ordering of society. For example, "theological arguments about the 'nature of humans' or 'natural rights,' resting as they do on the concept of creation, meet a look of blank incomprehension; in fact, they seem nonsensical, the relic of an archaic 'natural philosophy'."[178] In reducing "human nature" to the mere biochemical structure of man, it is impossible to make ethical statements. All that can be done is state what is feasible, not what is moral.

Developing the thought of the Swiss biologist and philosopher, Adolf Portmann, (1897 – 1982)[179], Benedict illuminates the problem of the behavioral sciences "adopting" the concept of nature for their own ends. The fundamental difficultly is that this kind of naturalness does not exist in man. Portmann uses the term "natural artificiality" to describe the different types of human society and points out how whatever aspect of human social life is considered, e.g. language, government, family life, etc., everything is dependent on decision-making. Benedict asks: "Where is decision making going to find its criteria? Are humans 'condemned,' as Sartre thought, to finding themselves in formless freedom?"[180] This will indeed be the case if creation is not granted its proper status as the "metaphysical middle term between nature and artificiality."[181]

In the second form of concealment of the concept of creation, reaction against technology develops into resentment against humans. Mankind is the enemy of nature, disturbing its "natural" balance and causing it harm; man uses his mind and freedom to the detriment of nature. For example, the French enthologist, Claude Lévi-Strauss (1908 – 2009) and the American psychologist, Burrhus Frederic "B. F." Skinner (1904 – 1990), take up a

[178] Ibid., 92.
[179] Adolf Portmann, *Biologie Und Geist* (Göttingen: Burgdorf, 2000).
[180] Ratzinger, 93.
[181] Ibid.

line of thought in which "humans must be healed of being human."[182] Skinner would even go so far as to say that free will is an illusion. Benedict notes that both of these men express a perspective that is becoming more and more widespread and contributing to various forms of nihilism among young men and women in the historically Christian west.

The final form of concealment is profoundly theological and related to the two aforementioned types: nature "is robbed of its belonging"[183] by grace. Looking to the New Testament, Benedict draws insight from St. Paul: "It is not the spiritual which is first, but the physical, and *then* the spiritual."[184] When the order is inverted, creation is rejected and grace is divested of its foundation. Far from elevating grace, according to Pope Benedict, "the undermining of creation can never become a vehicle of grace, but only of an *odium generis humani* (hatred of the human race), a Gnostic disenchantment with creation, which ultimately does not desire grace any longer."[185] For the Pope Emeritus, *agape* is heart of Christianity and the antithesis of Gnosticism. This distinctly Christian love presupposes faith in the Creator, self-acceptance as His creature, and concern for one's neighbor.

While the natural sciences are an *essential* discipline for understanding aspects of reality, reality itself transcends the natural sciences. According to Benedict, "Moral-religious" reasoning, in contrast to "physical-natural scientific" reasoning, is not a mere expression of superstition and subjective preferences. "It is in fact the more fundamental of the two reasons, and it alone can preserve the human dimensions of both the natural sciences and technology and also prevent them from destroying humankind."[186] Postmodern man seems very willing to make an act of (human) faith in favor of UFOs or the so-called "Mayan Doomsday" of 12/12/2012. With the help of Divine grace, an effective articulation of the Christian theology of creation can help these same men to see in the design of the universe a

[182] Ibid., 94.
[183] Ibid.
[184] I Corinthians 15:46 (RSV)
[185] Ratzinger, 95.
[186] Ibid., 46-47.

manifestation of the love of the Creator and have faith in the divine revelation of the *Logos*. For this reason, the Church hopes that men come to know the Lord who "out of the abundance of His love speaks to men as friends (see Exodus 33:11; John 15:14-15) and lives among them (see Baruch 3:38), so that He may invite and take them into fellowship with Himself."[187]

[187] Vatican Council II, *Dei Verbum* (1965), 2.

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