CREATION, REVELATION, AND THE EMERGENCE OF EMPIRICAL SCIENCE

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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 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 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.
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 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 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 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 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. 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 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 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 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]

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	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;

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?	

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 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 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 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.

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 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.

E. 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 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]

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] 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.

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.

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, 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 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]

F. 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, 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 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, 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]

G. 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 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 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 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.

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 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 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.

H. Conclusion

Coming to a satisfactory understanding of creation is obviously not an easy task. As the Reverend Jaki pointed out, 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, 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 Saint 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)."[111] 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.

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[1] Genesis 1:1-2 (RSV)
[2] S. Hawking and L. Mlodinow, *The Grand Design* (New York: Bantam, 2012), p. 180.
[3] W.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).
[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] E. Gentili and I. Tagliaferri, *Scienza E Fede : I Protagonisti : Sacerdoti E Religiosi Scienziati* (Rome: Istituto Geografico de Agostini, 1989), p. 287.
[6] Carroll, "Creation, Evolution, and Thomas Aquinas."
[7] P. Duhem, *Le Systeme Du Monde: Histoire Des Doctrines Cosmologiques De Platon a Copernic*, vol. I (Paris: Librarie Scientifique A. Hermann et Fils, 1913).
[8] C. Lancellotti, "Science, Contemplation, and Ideology", in *The World and Christian Imagination* (Baylor University: 2006), p. 5.
[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), p. 67.
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