Cosmology: A Case Study for Cognitional Comparison Using Lonergan

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I – Abstract

A method of discourse between science and theology through the medium of cosmology as a discipline. Exploring the modern theological works of James Pambrun, Ernan McMillan, and Hans Kung, as they pertain to the dialogue between science and theology, with direct application to historical and contemporary scientific understandings in physical cosmology. Modelled off the cognitional theory of Bernard Lonergan, as applied by a classical understanding of theological cosmology to an accurate scientific synopsis of physics as expressed by Roger Penrose and William Stoeger. Covering the topics of the heliocentric model, the role of mathematics, universal gravitation, the Big Bang, and quantum mechanics, from the impact of Galileo, Newton, and Einstein, as representative of the development of cosmology throughout history.

Une méthode de discours entre science et théologie à travers la cosmologie en tant que discipline. Exploration des œuvres théologiques modernes au James Pambrun, Ernan McMillan, et Hans Kung, relatives au dialogue entre la science et la théologie, avec application directe aux connaissances scientifiques tant historiques que contemporaines de la cosmologie physique. Modélisation à partir de la théorie de la connaissance de Bernard Lonergan, telle qu'appliquée par une compréhension classique de la cosmologie théologique à un précis scientifique de la physique concis, exprimée par Roger Penrose et William Stoeger. Études les sujets d'héliocentrisme, le rôle des mathématiques, gravitation universelle, le « Big Bang », et la mécanique quantique, depuis l'impact de Galileo, de Newton et d'Einstein, comme représentation développement de la cosmologie dans l'histoire.

II – Acknowledgement

Special thanks to Spock, for showing us that science and morality are not mutually exclusive. And special thanks to Leonard Nimoy, for having the courage to allow his faith to shape his public life, and to share it in his art.

1 – Introduction

Cosmology, like many academic words, leaves people with a vague impression they can not quite appreciate while simultaneously conjuring up very specific images. Images which nonetheless leave the layperson little more capable of decidedly expressing what it is that cosmology consists of. It is substantially easier to understand what cosmology means, and to determine if a given thought or concern is related to cosmology than it is to define the body of cosmology in its fullest. If you ask a child about their world, you may well get an answer that speaks about their family, the local postal worker, teachers, pets, and maybe even a great deal about their imagination. This is certainly the content of a cosmology, just as for an adult issues of environmentalism, justice, resource distribution, and the rule of law can be constitutive of a cosmology. With a review of fiction from the 1920s or even 40s, it does not take long to find images of a universe populated by angels on par with aliens, truisms about gender identity, or mechanical ideas about the politics of war.[1] This last is perhaps the fuzziest example of what might be considered cosmological content. By the end of the 1970s, popular scientists like Carl Sagan were coming to the fore[2], a more rigorously scientific content for popular cosmology was being proposed; one of black holes, quasars, quantum mechanics, and string theory. What then does cosmology mean?

Let us first acknowledge that it is unsurprising more and more universities are running head-on into the intellectual minefield of cross-disciplinary studies. It is practically a given that being a contemporary specialist in one field of study overlaps with the content of other

1 C S Lewis', The Space Trilogy (2013), comes to mind. The first of this trilogy was actually published in the 1930s, a series that takes the idea of the cosmos as a divinely populated space quite literally. Though an unabashed theistic approach to science fiction, allusions to the divine are a common source of material for science fiction, especially as related to existential and moral humanity.

2 Carl Sagan's, *Cosmos: A Personal Voyage* (1980), first filmed in 1978-79 could easily be heralded as the formative source of modern popular cosmology in the Western world.

specialists' interests. For those that are not experienced with cross-disciplinary studies, it is perhaps easiest to understand how biology and physics can be combined into the discipline of biophysics – essentially a study of the physical mechanisms and processes of living organisms. Perhaps too, one can find it easy to understand how the faculty of law can benefit from delving into the social sciences, especially as it relates to marginalised people and/or social classes. Both of these examples are clear inter-disciplinary studies which have transformed traditional boundaries within university faculties, and consequently resulted in very real benefits to our understanding of their areas of interest. Similarly in the humanities, such as philosophy and theology, breaking down the isolation of disciplines has resulted in strides of human understanding without diluting the value of the faculty itself – perhaps this is harder to see for many people, but it is certainly exemplified in areas such as ethics and conflict studies.

1.0.1 – The *What* of Cosmology

With the above firmly in mind, and for the purposes of this work, let us begin by conceding that cosmology is the study of knowable things related to the "world" at large, and as it is. That is to say, it is an exploration of the essential nature and qualities of the world. This includes the full range of intellectual understanding up to our mental horizons, not excluding a critical perception of our suppositions, and most certainly extended indefinitely wherever, whenever, and however those horizons shift. Cosmology is the study of no less than the entirety of the nature of existence, physical or otherwise.

One's immediate impression may be that such a description is most truly the concern of philosophers. Historically, at least in the West, this would seem to be a safe assumption. When

we look at such classic philosophers as Socrates, Plato and Aristotle, philosophy is not a simple exploration of esoteric intellectualism. Philosophy must stay firmly rooted in what is real and present for the human condition. This would include a study of the gods, sciences, and politics (by modern sensibilities a not altogether clear distinction is made between these). Extend this trend with the works of modern philosophers such as Immanuel Kant, David Hume, Blaise Pascal (a mathematician, as much as we think of him as a philosopher), and the role of metaphysics becomes an increasingly obvious concern.[3] And so it is, that cosmology is the epitome of cross-disciplinary interests.

It is no wonder the content of cosmology is difficult to comprehend. While *physical cosmology*[4] restricts itself naturally to the scientific order of things, often imprecisely constrained to astrophysics, though it includes subatomic, particle, temporal, and quantum physics in as much as any of these specialities bear on the scientific model being explored. Crassly, but not inaccurately, these cosmologists study the very large and massive and the very tiny and energetic. These cosmologists make use of the extremes of the natural universe to define its perceived boundaries and even extend that perception to broach more fundamental bounds.

Much more general are philosophers who explore cosmology with terms like ontology, epistemology, existential, meaning, reality, and so forth. In this case, the boundaries are not the observed structures of science, but the reasonable extensions of any given intellectual pursuit as it pertains to the content of philosophy in general. It is certainly key to keep in mind that while a scientist is keenly interested in the nature of what "is" (as in those objects which we sense and

3 Alfred Whitehead's, Process and Reality (1990), is clearly a good example of the role metaphysics plays in the philosophy of modern science and mathematics, and thus of course cosmology. The problem that we would face by bringing his work specifically into this discussion, is that we would be interminably bogged down by the philosophy before ever reaching the goal of our discussion – the relevance and importance of theology in modern cosmology.

4 By physical cosmology we mean specifically cosmology as defined within the discipline of physics.

measure), that a philosopher of science, while likely personally interested in the same, academically is more interested in the importance of the science as process as well as the significance of what "is". In a real sense, the nature of an object to a scientist is the set of all possible measurements of that object. In an equally real sense, the philosopher of science is likely to ask what is the nature of those measurements themselves, regardless of the object being measured. Again philosophers are testing the bounds of reason, though this time not on the objective phenomena of the existent as science does, but on the objective (and even subjective) criteria that might make an otherwise reasonable philosophy no longer seem reasonable.[5] In this sense, and with regards to philosophy, the content of *philosophical cosmology* might seem less restricted than physical cosmology, but then it could also be hazarded that most contemporary philosophers are cognisant, and thus cautious, not to confuse the discipline of natural philosophy (or the subset of philosophy of science) with the discipline of science itself. Thus they generally stop short of claiming any sort of absolute scientific knowledge of the universe, and instead are content with at most evaluating what science can and has done versus what science could or cannot do.

There is an entire discussion to be had as to whether the boundaries of our imaginative and constructive mind are greater than the boundaries of the real, physical world, itself. Do flying elephants exist? Would the universe be bigger or more full if they did? Are we capable of knowing more than there is to know, or are we even capable of knowing each one of any of the possible things in particular that there are to know, let alone all of them at once? Issues which

5 A simple reading of David Hume verses Immanuel Kant with respect to the nature of knowing a thing highlights quite poignantly the idea that a philosophy can be accepted as seemingly reasonable and yet be demonstrably unreasonable from another perspective. Such debates were core to the philosophy of science until Karl Popper presented the theory of falsification as being the key character that differentiates good science from bad science, and shifted the nominal sense of scientifically knowing a thing to one of a more practical assertion of value. (Popper, 1968)

are directly dealt with in reductionism (and counter theories thereto). Saint Anselm's second "ontological argument" (Himma, 2018), and Thomas Nagel's "What is it like to be a bat?" (Nagel, 1974, pg. 435-450), are both classic examples of arguments which rely on some conception of this issue at large. While neither is about cosmology in a proper sense, they both set a clear tone as to why cosmology is an inherent manifestation of existential concerns.

1.1 – Theology and Cosmology

Theology has its own study of cosmology, from the not so humble arguments of the divine spheres, to the essence of God, and our ability to know right from wrong. Cosmology to a theologian varies from faith to faith (institutionally and personally), as much as it does from denomination to denomination, and theologian to theologian. Without getting into the vagaries of religious belief and religious identity as part of human psychology, it is easy to recognise that there is a difference of importance to various elements of any religion as noted by the formal teachings of said religion, as well as the personal convictions of those who claim membership therein. It is therefore axiomatic that the religious community (as either externally or internally recognised), and the personal beliefs of the thinker, play critical roles in the diverse potential for what is or is not deemed important to a topic as broadly defined as cosmology. This is not to say there is nothing objective in defining what ought to be considered relevant to cosmology (that is essential to our thesis) but that there are functionally many disparate views on the modern issue.

None of this is simply a matter of relevance to each beholder, but a matter of understanding the foundations of their faith itself and the natural extensions of meaning which those foundations may inspire. What do we mean if we say God is infinite, or infinitely

compassionate, or when we speak of heaven, or hell, incarnation, sin...? Here one's mind might go towards that of the "Cosmic Christ", whether one's thought leans to the words of Richard Rohr, or those of Teilhard De Chardin, it does not serve our purpose to get side tracked by a specific theology or theologian's mysticism. It would be particularly tempting to critique Teilhard De Chardin, both for the good and bad of his arguments, however it would be equally easy to get lost in a negative criticism of new age mysticism, Jesus the scientist, and pseudoscience. Hans Kung (whom we will reference more later) recognises the relevance of Teilhard De Chardin's work, as well as the earlier mentioned Alfred Whitehead, in relation to this conversation. (Kung, 2007, pg. 97-102) These are not small topics, and depending on the theology in question each is more or less cosmological in extent – in the least with regards to how it changes the theologian's understanding of their place in creation.

Here we have said "creation" which comes with a whole host of concerns and suppositions, but not any more so than "world", "universe", or "reality". Each discipline has a preferential term to bandy about so that they might indicate the fullest extent of that which is the content of cosmology when compared to a mere subset thereof. Creation in this context is probably recognisable to most Christians, and certainly Catholics, as that which is not God himself, but brought about in some manner by God, and in that sense is all that exists which is not properly thought of as God (*Catechism of the Catholic Church*, 2003, #290). Hans Kung explains this in more depth, yet fairly succinctly (Kung, 2007, pg. 120-125), with reference to Augustine's Confessions, though with added nuances that we will not specifically address. There are variations on exactly how much exists (one can easily think of arguments regarding creationism, or historic cosmologies involving a flat earth) but just as easily this subsumes all the

possibilities of physical universes, platonic planes of idealism, and any sort of transcendent afterlife; though the potential of this content depends as much on the faith (again both institutionally, and personally) engaged in the discussion. In this regard, *theological cosmology* is the one which potentially has the greatest scope of interest.[6]

Still, theological cosmology is also prone to being the most eccentrically restricted inasmuch as the relevance of other disciplines may be unceremoniously dismissed as irrelevant or even forcibly seen as subject to theological approval. One modern example of the latter is the current trend in some Christian communities towards pushing creationism in youth education. Particularly the position expressed by groups such as *Arc Encounter* (Answers in Genesis, 2019), wherein modern science is shoehorned into the group's interpretation of biblical scripture. Of course scripture has a role in theology, and as such if theology engages with science there must be some way in which scripture and science are mediated to one another, but does it (or even should it) be so literal? Later, in chapter 2.1 – The Heart of Division, we will discuss the classical example of geocentric verses heliocentric models and what impact Galileo has on our topic. In the case of our former referent, we need not look any further back than the topic of creation, insomuch as many atheists see physical cosmology as a refutation of any validity to the Christian concept of God's act of creation. This too will be discussed more fully, specifically in chapter 2.3 – It is All Relative.

6 This is a personal assertion, meant in the quite literal way in which a bucket is greater than a mug (it encompasses more stuff), and is not meant to imply that there is objectively a greater level of academic or practical interest espoused by theology than either science or philosophy, in regards to the content of cosmology.

1.2 – Our Hypothesis

Up until now we have broadly defined the parameters of three discipline specific meanings (physical, philosophical, theological) for cosmology, and even then, none were so well formulated as to explicate their content specifics to a layperson. Politics, sociology, psychology, each have their own intentions behind the term cosmology; what is more, for many even inside the same faculty the meaning of cosmology varies in its practical application.

Is there then such a thing as the proper content for cosmology? The short answer is no, the long answer is yes; any proper content depends on the perspective of the investigation and its own authenticity. This is why we will be introducing the thoughts of Bernard Lonergan (in chapter 3 – A Methodology in Formation) to the conversation. Not to determine the proper content of cosmology, but to inform us as to how to evaluate the authenticity of a discipline's content thereof. From here on we will be concerning ourselves with the content of physical cosmology (that of the theoretical physicist), philosophy's interest in cosmology (that of the ontological and existent reality by way of method), and theological cosmology (the nature of God's creation). We will not, however, be properly explicating, justifying, or exploring the full extent of the discussions in each of these disciplines. Instead, we will be arguing that there is an inherent relationality implicit in each of these, which not only accounts for the blurring of our common perception of what we mean by cosmology, but which also properly outlines a topic for discussion – one which all three might agree to having. By this we mean to show that there is a proper content for cosmology that all three disciplines will not only recognise, but with respect to which each of those disciplines can accept some form of beneficial contribution from the others.[7]

7 At the moment this last part begs some indulgence from the sceptic as it is notably an unpopular idea. However, this is our thesis; not a wild claim we expect to be accepted as either a premise or condition for this paper's ongoing arguments.

Further, we will be restricted from the formal content of physics and philosophy to such an extent that, while their cosmologies and cosmological interests might become exemplars to explore, we will only be discussing their interest and the implications thereof and not properly the content itself. This is to say that while star formation may well be important to a cosmologist in physics, there is no expectation that the reader be able to follow (let alone understand) the astronomy that, or mathematical calculations which, are the physicist's acumen. However, the fact that the physicist's tools are what they are is pertinent to the discussion as a whole, so this role will not be ignored (even if a functional understanding of such topics as optics and calculus will not be expected or gained in reading this).

In short, we are interested in the meaningfulness of their cosmologies, and not the precise details therein. This is key to any resolution to our question. It is not so much what each discipline does with the information they deem relevant, but why and how they deem it relevant which may lead to a meaningful dialogue between them, and within the auspice of cosmology. Why is physical cosmology bound to mathematical models and predictive outcomes? Why does philosophical cosmology revolve around cause and effect, determinism, and tautologies? Why does theological cosmology focus on creation, our relationship to God, and the so called problem of evil? In the case of all three, how would they respectively answer these questions? As we will discuss, it is not epistemological differences between theology and science themselves which are in question, but rather recognising that regardless of these there is a cognitional commonality; as such one's ontological claims are not dismissible a priori, solely on the basis of the other's criteria.

As an even greater restriction, though it is tempting to want a case for theological

cosmology in general, we will only be exploring Roman Catholic cosmology as one formal study of cosmology within theology, and not as the doctrinal cosmology of the Catholic Church or any other one in particular (we are not interested in how many angels can dance on the head of a pin). This comes down to what some might feel is the role of theology within the Christian religion. The position we are taking is precisely that of Saint Anselm's “faith seeking understanding” (Williams, 2016), that we as theists first have faith and thusly seek to rationally explore that faith, both for our own edification and for those whom are perhaps less so inclined. With that in mind, exploring the particulars of a given doctrinal statement relevant to Roman Catholic cosmology would be no more constructive to this discussion than revisiting our earlier prohibition towards advanced mathematics. In actuality, exploring the theology that takes place in, around, and behind, the sentiment of doctrinal statements is more precisely germane to the whys and hows we spoke of in the previous paragraph.

Why Roman Catholic? In part because this is the source material that has been chosen, but that choice itself was made because of the character difference within Roman Catholic interests regarding cosmology as compared to other denominations and faiths. There is simply too much breadth and there are too many nuances within the broader Christian moniker (let alone non-Christian faith groups) for us to explore a wider faith base. Still, it is reasonable to expect that this will not prevent our conclusions from being extensible to, or even critical of, cosmology as explored in other theological communities. We have already mentioned *Arc Encounter*, an example of fundamentalist American Christianity; this, along with the work of Anglican theologian and physicist John Polkinghorne, will be briefly mentioned in contrast to our chosen Roman Catholic method later in a chapter 4.5 – Modern Sensibilities, as we apply our method.

1.2.1 – Reasons not Justifications

Of course knowing the discipline and even the content of a specific topic does not on its own inform us as to what the material interest of that topic is. Each of these disciplines has a myriad of subsets that further rarefy the nature of a proper discussion within them. For instance, science differentiates between its view of the why(s), the what(s), and the how(s). Roughly this is the theory, the observations, and the "science" (science meaning an accepted form of methodology). Of course even these have sets. In theory there are the why(s) that pertain to reasoning what our observation has witnessed, and the what(s) that help us to orientate our curiosity towards new discoveries and the recognition of new phenomena. In practical science there are the observations themselves and the resulting classifications of phenomena – both arguably what(s). So then in the field of physical cosmology, where are we to be looking in this paper? Practical science is an autonomous, rigorous, endeavour to observe and classify phenomena. In this sense it wilfully, and with self-consistence, is disinterested in what other disciplines have to say about what it is doing. There is of course some grey area in as much as one might argue about what is "good" verses "bad" science. As well, some argue over the proper place of ethics in the role of scientific advancement. To be honest, while there is plenty to discuss here it is not rightly relevant to our topic.[8] It is not irrelevant to cosmology, just not to our discussion thereof. Theoretical science[9], on the other hand, while also rigorous in principle, relies on a whole host of human intellectual forms and social contrivances. In no way is this an

8 More can be read on the contemporary theological situation of this topic in the works of Robert Russell, but for a review of his position in general consider Scott Ventureyra's "Theology's Fruitful Contribution to the Natural Sciences: Robert Russell's 'Creative Mutual Interaction' in Operation with Eschatology, Resurrection and Cosmology" (2009).

9 Here I am referring to the difference between doing science as perceived solely as an exercise in experimentation and careful observation, verses the acts in science involving speculation, modelling, and interpretation, as evidenced in the thought experiments of Einstein or mathematical inquiries of Stephen Hawking, for instance.

argument regarding the triviality of theory – its arbitrary, or relative nature. What it is, is an acceptance of the human character of engaging in science. This is where we will be broaching physical cosmology, through the lens of what theory, and theoretical scientists are doing (though backed by proper observation); the why(s) and the what(s), and the why and the how behind their authority.

Philosophy as well has different modes, methods of engagement and rationales for those methods. In our case we might argue about the many what(s) that philosophers might be concerned with regarding cosmology, but this is not strictly going to be the case. For us, philosophy will be a tool; a tool not for the discovery of cosmological content, but for the discussion of what warrants a cosmological moniker. Analytically it will serve as a proof of logical integrity, but also linguistically as a guard against the inherent isolationism that results from discipline specific language drift.[10] This is essential to understanding the how by which each of the disciplines measure their own credibility. In this way it will serve for discussing whether what we are discussing is in fact cosmology, and rightly why it is that one of the other disciplines calls it cosmology. However, in claiming to do this, we do not want to get bogged down in a philosophical discussion about what philosophy is saying about cosmology – just what is philosophically relevant that the other disciplines have to say. That is, those things in

10 Wittgenstein established the fairly basic (if complexly understood) concept of language games; the idea that meaning in language is inherently possessed not in the simple use of the language proper, but within the social context of the the language's use. Housed within this is the idea that added layers of nuance are built upon previous generations of use, but those previous complexifications do not have to be expressly understood for the future uses to be meaningful. All the same, exploring the previous iterations may allow an outsider to decode the more nuanced and complex uses which a community otherwise implicitly understands. (Wittgenstein, 1968)

For an even more in depth exploration, one could read the works of Noam Chomsky on the philosophy of language, and how language use drifts between communities of users. Many other linguistic philosophers deal with the topic, but I find Chomsky's disposition towards an existential character – if only in structure – of language (natural language) is somehow sympathetic (poetically speaking) to our exploration. For a quick primer to Chomsky's theories, one can read: Binoy Barman's *The Linguistic Philosophy of Noam Chomsky* (2012).

cosmology that are professed, discovered, or “known” from the other faculties, and on which philosophers would lay some claim that their input is of relevance. This will be of particular import when we explore Lonergan's method as a practical exercise, in chapter 4 – Constructing a Discourse, and how it pertains to resolving our thesis.

Theologically speaking then, how are we further directing our attention? Here is the crucial point of this entire paper, that theology (and specifically within a Roman Catholic context) is relevant to the discussion of cosmology. Not just as some Roman Catholics may like to claim, but in as much as there is something we can or are doing which is worth discussing with physical and philosophical cosmologists alike. This is not a claim that we can impart cosmological knowledge in the proper sense as either of the other two disciplines would define it. This paper will not defend theologians doing “better” science than scientists or more “proper” philosophy than the philosophers. What it will ultimately propose is that in some way, when theology is responsibly speaking of cosmology, and as it pertains to similar concerns for the other two disciplines, that theology is doing something both unique and relevant to the understanding of cosmology as a whole. That theology is not so much informative to the content of physical or philosophical cosmology, and thus not to the what(s) of those disciplines. That theology is, nonetheless, formative with respect to the reasons for which the others are doing so, and to the significance those reasons play. That theology is present, as it were, at the beginnings and ends of the discussion. To again reference Lonergan's ideas before formally exploring them (once again, chapter 3 – A Methodology in Formation), it is key to the authenticity of each of the disciplines as an exploration in intelligibility and meaning. Furthermore, in doing so, when “good” theological cosmology is doing what it is meant to do, that it is in fact engaged directly

with the what that other disciplines interested in cosmology are doing.

Before we begin exploring exactly how theological cosmology and physical cosmology can engage in a mutually informative manner it is important to do two things. First, we must show that there is a desire or need for such a relationship. Second, we must articulate a theological method which is appropriate with respect to exploring the other discipline. This latter must be done without compromising the sense of the other's discipline's autonomy. Because this is a speculative exercise, the desire or need does not have to be more than one sided. In fact, even if one sided it does not actually need to be explicit. The ultimate proof of such a desire will come when members of one of the disciplines openly accepts the challenge to engage (hopefully using the methodology we are suggesting) with the other, and the need will be proven in the efficacy of any resulting interaction (i.e. once a practical result has been achieved by means of our method). Practically this means our proof can only be one of concept, and will not be any sort of unassailable, authoritative justification for the union of theological and physical cosmological disciplines. Still, it helps to encourage if not simply point out the whys and wherefores that lead us to think both the desire and need exist.

1.3 – Thesis Structure

An historical review of how cosmologies in either discipline have functionally interacted in the past, as well as a few contemporary examples of interest or admissions of curiosity, will go a long way towards the aforementioned encouragement. To this end, chapter 2 – Cosmology in History, will rely largely on the writings of Ernan McMillan, Hans Kung, and Roger Penrose, in exploring the history of the birth of modern cosmology as it separated itself out into those

subsets that of theology and that of science.

Following this, chapter 3 – A Methodology in Formation, we will explore the methodology of Bernard Lonergan. This should form the basis for much of our methodology, particularly Lonergan's conception of interiority and cognitional processes. This is not simply stripped from Lonergan's works, but guided by the interpretations and explorations of James Pambrun and his research on other theologians and philosophers in hermeneutics. Pambrun has already spent a great deal of effort on exploring how a mutually informative dialogue between science and theology could be supported through the works of Lonergan and these other scholars; his explorations will serve as the guide from which we will refine Lonergan.

We will then be able to apply this work specifically to the cases of theological cosmology and physical cosmology, culminating in the practical application of our appropriated method, in chapter 4 – An Application in Discourse. Here we will reference some of the works of William Stoeger (a respected Catholic scholar of physical and theological cosmology), among others and Roger Penrose (and espoused atheist, and one of the pre-eminent scientists of cosmology) in an attempt to see what insight is gained.

Our conclusion will follow, hopefully convincing the reader not of the surety of our efficaciousness, but of a genuine possibility for a more robust conversation between theology and physics, if in no other venue than the academic circles of cosmology's study.

2 – Cosmology In History

There are plenty of events in western history to which one may point as seminal in the birth of science. The choice, it seems, is to what character of science, its focus, modern use, or

particular insight, one is trying to highlight. Cosmology is no different – theological or physical – that being said, tracking its history might seem easy enough from casual appearance but it gets decidedly more complicated as we peruse specific nuances and paradigm shifting developments. Pambrun, in "Science, Philosophy, and Religion", refers to Guy-Marie Bertrand's, *La révélation cosmique dans la pensée occidentale*, 1993, wherein 560 pages of formal historical references are included, which speak to this. (Pambrun, 1994, pg. 275) Many would cite Sir Isaac Newton, the man credited with our classic understanding of gravity and the development of our modern mathematical approach to science. Others may claim it is necessary to look closer to now, recognising that Newton had an understandably naive perspective as to just how large and awe-inspiring the universe is. Those with an interest in natural philosophy might simply go back to the Greek fathers, like the Pythagoras and followers thereof. There are a couple of conditions then, in the context of this paper, which it bears to set. If we agree, as we have, that theology, philosophy, and science all have some natural (or at least personal claim) to cosmology, then at what point did these faculties divide, or at least divide their interest? The answer, most anyone could agree on, is Galileo. Not because Galileo took one side or the other, it can certainly be shown that he did not differentiate these disciplines the way modern minds do, but because it is the historic conflict between Galileo and the Roman Catholic Church, as well as Galileo's discoveries, which set the tone for pretty much the entire discussion of cosmology as we think of it today (regardless of the discipline under which it is studied). Further, both scientists and theologians alike can agree that Galileo is seminal to our modern understanding of the cosmos. One thing that must be noted above the rest, is that we have to highlight what Galileo did for nascent cosmology irrespective of the conflict that usually colours our understanding of Galileo's

role in history. Essentially, we have to unpack his intellectual contribution from the politics of his historical importance.

2.1 – The Heart of Division

In 1633 Galileo Galilei was placed under house arrest, in 1642 he died, it was not until 1992 that Pope John Paul II officially acknowledged that the Church erred, at least in part, in the handling of Galileo's case and its conflicting perspective with Galileo's work. It is all too simple to suggest that this conflict was nothing more than controlling clericalism exerting its political will on the objective and innocent efforts of the scientific community. The irony is that the depth of the affair is far more complicated, and in a sad way, not unfamiliar to our social reality today. Galileo had produced a collection of systematic, celestial, observations which he considered physical proof of a nearly century old theory that Earth in fact orbited the sun, and not vice-versa. This is just a nutshell version of the contents covered in the book The Church and Galileo[11] (McMillan, 2005), in which a collection of essays explore the political, theological, and scientific situation surround the time of Galileo, in particular (though not exclusively) his publications and trial.

In our case there are two particular things we can take from McMillan's book. The first is that despite the results, and even perhaps some of the motivations, theologians of the day endeavoured to use the best of their science – in as much as a sceptical mindset was used – to best find reason behind the observations of our senses. (McMillan, 2005, pg. 78) The nature of that reason is of course suspect to a modern scientist, but then it was another generation before

11 To some degree this publication is a response to a dissatisfaction with the aforementioned statement from Pope John Paul II.

Newton and the introduction of a mathematically supported theory of universal physical laws; which had they been known, may have superseded the politicisation of the entire conflict. Secondly, if only for the purposes of our argument, the historical divide between theology and science which the entire affair represents might also be accounted as the historical moment for a modern burgeoning of *bad* theology. (McMillan, 2005, pg. 41) This is not a condemnation of modern theology itself, but a recognition that the legitimisation of an intellectual trend in the seventeenth century set the tone for a conflict between the disciplines that we are obviously still dealing with today, and which this paper is trying to set aside. Rhetorically speaking, is it really a surprise that this conflict engendered prejudice between the disciplines, in both directions?

2.1.1 – A Matter of Perspective

For now, let us set aside the the political significance of the Galileo affair, and focus on how Galileo's thinking was both grounded in that of the day, but similarly opened academics to the thinking of modern science. To begin with, Galileo was responding to a specific observational reality of our world (the motion of heavenly bodies, specifically the known planets of the day – thought simply as celestial bodies that wandered the sky) and both the theological and philosophical position of the day (that God made the world in such a way as to be intelligible and thus in a sense predictable – outside perhaps of interference by the miraculous). The problem was that there was no simple, precise, predictive as to how these planets would move, just a general understanding through time. Nicolaus Copernicus had already introduced a model of the heavens that was apparently able to solve this. However, this model was thought of as essentially a mathematical exercise, to make predictions easier, and not thought to necessarily

reflect the actual reality of the heavenly bodies' motions. (Kung, 2002, pg. 3) Think of this situation as you might a world map. We are used to using a rectangular map of the world, it is good enough for use on a daily basis to figure out where we are with respect to travelling somewhere else. In reality (and in Galileo's era as well) we know we live on a planet that is roughly spherical, a globe. Two-dimensional maps are mere abstractions (no matter how effective) of the reality, reflective enough to be useful but not true images of that reality. What sets Galileo apart is that he endeavoured (successfully) to see the mathematics as reflective of the actual reality. That there was a direct and real correlation between the predictive capacity of the mathematical calculations and the actual movement, moment by moment, of the celestial bodies. Mathematics could be used to "know" something without actually witnessing it with the senses. In the case of Galileo, his observations indicated that the Earth *actually* orbits the sun, not simply that it is mathematically convenient to think of the Earth as doing so. (Zeilik, 1992) Additionally, Galileo observed that the remaining stars must be huge objects at great distance from the Earth, and not simply points on a comparatively nearby shell, of a similarly comparatively small size. It is worth noting that these great sizes and distances were little compared to what we know them to be today.

Of course this disposition towards mathematics did not develop in an intellectual vacuum, and thus not spontaneously. The Pythagoreans had espoused belief in the realness of mathematical truths[12] (Penrose, 2004, pg. 39), Galileo is simply the first to proficiently demonstrate it in a physical, and directly observable manner as it relates to the large scale

12 The Pythagorean theorem states that the square of the longest side of a right-angle triangle is equal to the sum of the squares of the remaining two sides. The notable physical anecdote which demonstrates this is that if one lays three square tiles at a right-angle next to four identically sized tiles, then five such tiles will fit the exact distance between the furthest inside corner of the third and fourth tile rows respectively. This is still used in carpentry today, called the 3-4-5 method, to verify that walls and fences are being built at a right-angle to existing walls, and is as perfectly exacting as the measuring tool being used.

observable world – the cosmos, at least as evidenced by the shear number of times Penrose references his discoveries, mathematical ideas, or general impact on future physics. (Penrose, 2004) It is also worth noting that Johannes Kepler, and his laws of planetary motion, had a similar disposition towards the realness of mathematics (Kung, 2005, pg. 4), however perhaps due to geographical and geopolitical reasons, his theories (though still censored in the Catholic world, and still foundational to the scientific revolution) are less informative to a discussion about conflict between theology and science.

2.2 – What is Real

These attitudes regarding mathematical descriptions as truth are still relevant in science today. We often use mathematical abstractions to predict the behaviour of physical reality without actually ascribing the mathematical models the status of being true to reality, however, we also often create mathematical models which are meant to be seen as true in this real sense. Knowing the difference, and in that sense, being able to discern the difference, is a regular source of consternation between observational, theoretical, and computational physicists. A popular example of this challenge is the contemporary *Copenhagen interpretation* of quantum physics, when considered real.

Most of us have heard of the *Schroedinger's cat*... That poor feline – the one trapped in a box – possibly dead or alive, all dependant on whether a random quantum event has activated a poison vial. If real, the Copenhagen interpretation means that the cat is somehow both alive and dead, neither status having been cemented in reality until the cat's vitality is actually observed. This interpretation is an example of the mathematics being interpreted as an actual reflection of

reality. For many, it is also the accepted interpretation, it is true. What most people do not realise is that Schroedinger proposed his cat scenario as logical proof that believing the mathematical model of quantum theory to be real, in the case of the Copenhagen interpretation, was foolhardy and patently unreasonable. (Penrose, 2004, pg. 782-791) Academically, the model is seen as merely a representation, a convenient tool. So then, what is truth?[13] This is not a question for theologians to answer for scientists, but perhaps the need and desire for asking the question is a point of contact for all of us, and thus it is something we will get back to (in chapters 3.1 – Beginning with Knowing and 4.3 – Authentic Interiority).

Well prior to Galileo, in fact dating back to ancient Greece, the concept of celestial spheres dominated the cosmological notions of natural philosophers. This notion that various layers of specific heavenly bodies orbited our location, each layer fixed and responsible for the motion of the body or bodies therein. The exact nature of these spheres varied according to the ages, and by the time of Galileo were generally seen as being literal things, if of a non-solid nature. Copernicus mathematically re-organised the spheres so that the sun became the centre, around which the Earth and spheres rotated. (Rabin, 2015) Still, it was the spheres that emboldened and ensured their constant and predicted motions. Similarly, Kepler modified the Copernican system of spheres to reflect the non-circular motion for the planets which his own observations suggested. (Di Liscia, 2017) We can, of course, easily think of the celestial spheres as an impediment to, even a restriction of, science, but surely this would be disingenuous. At this time there was no modern theory of motion (a classical theory the specifics of which most people are not likely aware of, and whose predictions people therefore take for granted). The idea that action occurred was essentially ascribed to one of three things. In the case of thinking

13 John 18:38

beings, the animus, the desire or thought to move... After all, I think of my body acting (such as walking) and thus I walk. God's will; unlike physical beings, God's will is so efficacious He does not require a body to enact motion. If God could speak the cosmos into existence then certainly He could merely will a thing to move. Lastly the inherent character of the thing itself. That some things simply had the innate character of movement, the spheres of the heavens were these such things. Willed into existence by God, they rotated around the centre of His creation because it was their nature to do so. With this in mind, what is it that these historic scientists were to suspect moved the heavens? After all, nothing moved without either a mover, or the character of motion (incidently, material – earthly – things were thought of as inert, and thus lazy, incapable of moving without being moved). (Di Liscia, 2017) While Galileo challenged the perceived structure of the heavens, and proposed rules for the motion of things (such as gravity) he did not yet have a reasonable, and universal, scientific explanation for motion throughout the cosmos.

2.2.1 – A Shift in Consciousness

This is where Newton comes into play. Newton suggested the paradigm shifting idea that things do not move because of an animating will, but rather because of a force. A force being a real physical act that once it happens sets out an unchanging motion unless another force similarly acts to change said motion. Again, we take this for granted, but had Newton not had a mathematical model that correlated to real observed phenomenon, likely this would have languished as nothing but an unaccepted postulation. What was truly paradigm shifting about Newton's theories, however, is that a single, simple, formula predicted not just the motion of an

object falling from a height, but the way in which a pendulum swung, why two objects of different weights fell at the same speed, and most dramatically, the motion of every known celestial body along the elliptical paths discovered by Kepler. This was a universal law of gravity. (Halliday, 1993, pg. 412) We had, at this point, our first mathematically articulated reason for the behaviour of the world around us, the first of what appeared to be a universal law. Practically over night the celestial spheres became unnecessary contrivances, gravity was demonstrable, and its effects were universal as well as predictable through abstracted reason. Please allow Penrose to drive home the grandeur of this discovery:

> In the case of gravity, the accordance between theory and observation is especially clear, because of the very detailed observations of the planetary motions in our solar system. Newton's theory is now found to be accurate to something like one part in 10^7, which is an extremely impressive achievement, particularly since the accuracy of data that Newton had to go on was only about one ten-thousandth of this (a part in 10^3).
>
> (Penrose, 2004, pg. 390)

To make this clear, Newton based his theory on data that allowed him to be accurate to one part of 1,000. We now know, because of better and more sophisticated measurements, that his theory is accurate to one part in 10,000,000.[14] This is the equivalent of being tasked with estimating the height of Mount Everest and being wrong by less than the width of a pencil lead, without ever having to actually see the mountain.[15] One should think that this would be sufficient in demonstrating the value of good science as a form of reason to the most ardent sceptic. For our purposes, understanding the context of Newton is important for two major reasons, it is proof of concept for Galileo's disposition and the modern disposition of scientists in general, and it is also

14 In proper scientific notation, there would be no comma, but rather a space between each set of three zeros. However, for the sake of colloquial clarity, I felt it best to use the commas.

15 Newton's gravitational equation measures force, not distance, this is simply meant as an analogy of scale for those not versed in mathematical notation.

the stepping point to the next big scientific revolution in physics (which did not really happen for another two hundred years).

It is not of any surprise, for you reading or a scientific laymen in our society generally, to think of scientific achievements as having been built one upon the other, colloquially being referred to as an evolution of science. It ought not then be a surprise that scientific insight itself experiences an evolution of sorts. That each new and novel discovery brings with it the potential to shift the way scientists see the entire picture, re-framing even old discoveries not just with new insights, but paradigm shifting perspective (just as the birth of classic physics and its reliance on mathematics was paradigm shifting).

For everything the science of Galileo and Newton did for changing our popular and theological view of the operation of the cosmos; theologically this was not much more than a commentary on God's action in the natural world. Proof, of a sorts, that God did not have to be an active agent in the daily activity of the things that are. However, whether true or not this new science did not change our perspective on the material existence of the cosmos – the stuff of God's creation, and His creation thereof – so much as it changed our perspective on how that stuff operated and interacted with itself.

Before anyone objects on the basis of atheism in an era of reason, we are only discussing science in the historical moment, not philosophy, and then, only the efficacious proofs of science, not the disposition of some scientists. Still, to be fair, with the seemingly over-night discovery of effective physical science, is it any wonder that philosophers (and some scientists) were keen to abandon theology as being what they saw as little more than hearth wisdom? While some used science to excuse God from the picture, others chose to look elsewhere for the telltale signs of

God's presence and import.[16] It is worth hazarding that modern atheism really only garnered widespread scientific credibility with the birth of modern science.[17]

2.3 – It is All Relative

If at this point we introduce Einstein it should not come as a particular surprise. There are two major developments we will discuss regarding the impact of Einstein on the birth of modern physics. The most obvious first, his theory of relativity. Less known to the layman is his level of involvement in quantum mechanics (the existence of which we have already mentioned).[18] The theory of relativity, in its simplest sense, treats time as a variable. Up until this point in science, time was thought of as something absolute, that could be measured in increments that were the same for any person using a similar mechanism while counting it. What Einstein's theory supports, is that time actually moves slower for anything moving faster. So to the outside observer a long time may pass while for the mover a *relatively* short time may pass. For the most part this phenomenon is not directly noticeable due to the extreme speeds needed to approach that of light (that light has a finite speed is an integral part of the theory as well). However, it is verifiable by comparing synchronised atomic clocks (one flown for some time, the other stationary) and comparing their resulting difference. (Halliday, 1993, pg. 1106-1113)

16 Here I would be inclined to suggest readings on David Hume and Immanuel Kant. Traditionally we might think of either as being more interested in the moral landscape of human existence, but arguably in both cases the role (or lack thereof) of God in the existence of all things is foundational, and is ultimately based on their perceptions of reason and the contemporary science of their day.

17 I am not acquiescing to the popular idea that modern scientists are more or less a functional collection of atheists; that is a topic for someone else's paper and entirely beside the point. I am, however, suggesting for argument's sake that modern science has made atheism a more intellectually tempting position in mainstream society, which in all honesty is not only a matter of popular perception in secular society, but also sort of the implied motivation of my thesis itself.

18 As a matter of trivia, but one which is not given as much respect as it should be, Einstein did not win his Nobel Prize for his relativistic theories. It was Einstein's contribution to quantum theory which earned him a Nobel. Specifically, his work on the photoelectric effect and black body radiation. (Albert Einstein – Facts, 2019)

Another part of Einstein's relativity is that the more gravity a thing experiences, the slower time moves as well, and the more space is stretched.[19] This spacial phenomenon has been demonstrated through simple astronomical observation.[20] (Kung, 2005, pg. 9) The significance of Einstein's relativity, for our purposes, is that this marks the birth of modern physics.[21] It brought us nuclear weapons, but also predictions such as *black holes*, and the *Big Bang*. The significance of the nuclear age has been a topic for theology since its proof of concept,[22] as for black holes, these objects are the epitome of the hostility of the natural universe. Still, it is the Big Bang which concerns us most, because it is this theory which allowed us to first consider and explore the moment when not only the physical world "began" but also time itself, as well as how it might all end. It is no coincidence that it is often referred to as the "moment of creation". We had discovered God's pre-eminent act, or so some might argue, and which we will discuss again in chapter 4.5 – Modern Sensibilities.

2.3.1 – The Very Large and the Very Small

Let us return briefly to Einstein's Nobel Prize winning discovery. Thus far we have discussed challenging God's action in the world, and also God's creation of the world, but with

19 The Christopher Nolan movie *Interstellar* does a reasonable job of visualising this for the layman.

20 The warping of physical space by gravity also predicts gravitational waves created by extremely massive, fast moving objects (like a spinning black hole) and has only been confirmed observationally in the past few years. (Coheld, 2016) The original LIGO was being built while I studied physics as an undergraduate. I can admit that I wholeheartedly believed it would prove to be a failed experiment (because of the apparatus, not because I doubted the theory). While technically the original version did fail to yield results, I was happy to be wrong when the improved version succeeded.

21 Time dilation has very relevant effects in our practical, modern, everyday lives. Though not rightly relevant to our discussion, it is all the same quite interesting. For a quick and accessible read, consider Richard Pogge's "Real-World Relativity: The GPS Navigation System" (2017), and Mike Wall's "Einstein's 'Time Dilation' Gets Pinpoint Measure Thanks to Wayward Satellites" (2018).

22 I refer here to Robert Oppenheimer's famous quoting of the Bagavad-Gita. (PlenilunePictures, 2011) My professor of atmospheric physics at York University claimed to be a junior associate of Oppenheimer's during the Manhattan Project (I have no reason to doubt him), he also informed us that following this event, he had never seen a man so defeated as Oppenheimer.

the birth of quantum mechanics, science was effectively challenging our view of the nature of the created itself. Until this point, the general understanding of the nature of stuff (matter) was that is was acted on and thus moved and re-acted due to forces which transferred energy. This is essentially a universe consisting of one big mechanical collection of things moving according to predetermined rules of motion. The problem for science was that these mechanical rules did not conform to their observations of certain phenomena. One particular instance of this was that, hot objects did not glow with the light emission expected, but also, heating an object (specifically metal) with a light of greater intensity did not necessarily result in greater effects. Again, as a matter of scientific evolution, Einstein was also not working within an intellectual vacuum, he was building upon contemporaneous ideas about atomic structure, when he effectively showed that wave-particle duality explained this phenomenon. Specifically, that while light travelled as a wave, it was also effectively a collection of particles with specific energies. As it turns out, this wave-particle duality is a property of all matter and energy in the universe, according to the De Broglie hypotheses (after Louis De Broglie). (Penrose, 2004, pg. 501-503) Practically speaking, very large or comparatively slow objects act essentially as particles, whereas small or comparatively very fast objects act as both, if not waves. And here we have the birth of quantum mechanics, the idea that the material nature of the universe is inseparable from its energetic character. A corollary of this is that, at the most principle level there is no difference between what is matter and what is energy. What is more, random events and uncertainty are inherently part of all action in the universe; ultimately chance – and not some mechanism (coincidental or designed) – governs the nature of what is and what happens.[23]

23 Heisenberg's uncertainty principle, vacuum energy fluctuations, quantum-mechanical tunnelling, are all fascinating characteristics and phenomenon that are part of quantum mechanical scientific reality. Any of which can be looked up in Penrose's Road to Reality, or for a more approachable and possibly entertaining erudition, watch Jim Al-Khalili in the documentary, *The Secrets of Quantum Physics*. I would actually highly recommend

If we step back one last time, it was around the same time as Einstein's work that our observation and conception of the size of the universe expanded, from: our relatively local solar system of known planets surrounded by a field of bright clouds (nebula) and stars; to then the Milky Way (our galaxy) as a collection of independent (gravitationally influenced) stars, possibly with their own planets; to our current view of potentially trillions of galaxies, with potentially trillions of planets each. From a modern stance, we generally thank Edwin Hubble[24] for our understanding of just how large the universe might be. (Penrose, 2004, pg. 704) Every generation of star gazers ran across a wall, a cosmic horizon, further than which they could not see. As is often the popular way, this limit, this edge of what is known to exist, became the symbolic (sometimes literal) edge of what we conceived as being existence itself. Whether or not God created the universe, inside this horizon was all that there was. Interestingly, Kant speculated that with all the stars in the known cosmos, if the Christian God was as we conceived, then the heavens must be teaming with planets and ultimately life.[25] (Losch, 2016) Christian speculation of alien life in the eighteenth century!

Hubble was able to show that certain, fuzzy "stars" were in fact extremely distant galaxies in their own right. Showing the universe was bigger is not so important to our concerns, much more important was that Hubble showed that the universe was getting bigger, still growing in size but not in content. As it turns out, the universe is not simply growing, its growth is

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any of his documentaries to the laymen or simply as a refresher.

24 There is debate that Georges Lemaitre posited Hubble's ideas two years sooner; aside from the issue of proper credit, this is potentially of interest to us because Lemaitre was a Roman Catholic priest. (Clery, 2018) While Lemaitre was educated at a Jesuit school, he was ordained a diocesan priest. What is not a debate, is that it was his analysis of Einstein's work that lead to the theory of the Big Bang.

25 I suspect Kant's position was informed by the Church Fathers, and earlier popular thinking, for whom it is arguable that Creation in general ought to be filled with intelligent non-humans with unique relationships of their own to God as creator. But it also stands to remember that Kant was a natural philosopher who both studied and published on the scientific cosmology and astronomy of his day.

accelerating, and the further away something is, the faster it is accelerating. (Morrow, 2017) Growth in itself is perhaps of theological import, it proved that the creation of the universe was not the creation of a single, static, and thus eternal, entity. This, a hundred years ago, was an important enough discovery. However, we know now that it is not simply the universe on a cosmic scale that is expanding, it seems that all space is growing, even the space between atoms (because this growth is proportional to the distance between objects, the expanding distance at subatomic levels is functionally negligible). (Zeilik, 1992, pg. 432) Of course there are implications to an ever expanding universe. Unchecked, eventually all that exists will evaporate into effectively nothing but a very thin field of energy. The key there is *unchecked*, past theories have suggested the whole universe will collapse, and possibly bounce back in another Big Bang, creating a cycle of creation moments. Another suggested the expansion will slow to a stop, as heat continues to radiate amongst the planets and stars, what is left will simple freeze, stopping forever. (Penrose, 2004, ch. 27) Once again we will revisit these ideas, this time in chapter 4.5 – Modern Sensibilities, but for now, this completes our overview of the physical history of cosmology.

3 – A Methodology in Formation

If the previous chapter was heavy on science with some theology, then it must be confessed that this next section will be heavy in philosophy, and one might ask how exactly theology plays a role. We would only defend this partially, on the basis that Pambrun, Lonergan, and Ricoeur are all theologians (if multidisciplinary), but also on the ultimate fact that it is the necessary philosophical element of mediation we referred to earlier. In the 1993 issue of the

Lonergan Workshop, Pambrun proposed an interesting thesis which has formed a cornerstone for much of the work he continued to publish on the conversation of theology and science. This cornerstone is the complementarity of the works of Bernard Lonergan and Paul Ricoeur, and specifically how this may be fruitful if applied to the dialogue between science and theology. (Pambrun, 1993, pg. 101) While this complementarity is most certainly important, and Ricoeur's importance to the overall conversation should not be overlooked, we do not have time to fully explore another prolific author. Conveniently, the complementarity to which Pambrun refers is not strictly a dependant relationship in which neither the insights of Lonergan nor Ricoeur can be fruitfully applied without the other. Still, it is significant to the context that Pambrun proposed this combination as a solution to what was at the time a stymied attempt to address issues between science and theology within hermeneutics.[26] (Pambrun, 1993, pg. 99-100)

3.1 – Beginning with Knowing

On page 105, Pambrun presents with the first key to the significance of Lonergan's contribution to this conversation. Specifically the metaphysics of Lonergan; the "desire to know being"[27], combined with a recognition that both "naive realism and idealism" are the result of a frustrated common sense approach to knowledge. While Pambrun fleshes out his perspective here, it is worth looking at just how strongly Lonergan ascribes to this notion, stating that

26 The general history of conflicts (real, imagined, conflated, or succinct) between science and theology are not specifically relevant, more so because we have already acknowledge the role specific issues played in cosmology, but also because Pambrun was addressing a global issue for the sciences and modes of theology overall. However, it may be interesting for the reader (those that do not have a personal recollection) to look up the media and political climate around religious and scientific conflicts through the 1980s and 1990s.

27 The idea of being in knowledge is a ubiquitous idea throughout Pambrun's discussion of Lonergan. While perhaps relevant to cosmology, we will not be discussing the following: if such a sense of "being" can be applied to the Einstein-God problem. However, we will be exploring Einstein's reference to God, to a degree, in chapter 4.5 – Modern Sensibilities, since deism is certainly a relevant concern there, and if ever a cosmologist belonged quintessentially to both a Judaeo-Christian and secular scientific culture, it was Einstein.

“Mathematics, science, philosophy, ethics, theology differ in many manners; but they have the common feature that their objectivity is the fruit of attentiveness, intelligence, reasonableness, and responsibility.” (Doran, 2017, pg. 248) It is certainly worth postulating that this common root could be the beginning of the conversation we are looking to empower.

By page 114 Pambrun has honed in on an element in Lonergan's thought which is especially important (though for differing social reasons) to both theology and science.[28] Namely the importance of validity and judgment vis-a-vis the modality of doing science when science is done properly. By explicating the intelligibility of science's judgment Lonergan functionally demonstrates the validity of applying his model of cognitional processes in both the humanities and sciences.

Perhaps it is important to clarify, especially for scientists, that in knowing we affirm that that which is to be known is independent to the knowing, but it is not an affirmation that our knowledge is a true apprehension of that which is said to be known. Just that inasmuch as the thing is known, the truth of that knowing is independent of our subjective apprehension thereof. With respect to science, this amounts to confidence that science's method itself is sufficient to warrant that confidence when it is in fact successful at meeting its own expectations of rigour. (Pambrun, 1993, pg. 115) It is worth noting that all of this amounts not to minimising the epistemological differences between theology and science, but to recognising that both engage in the same cognitional processes despite their epistemological differences, and therefore their ontological claims are not mutually dismissible simply on the basis of not meeting the other's

28 I say differing reasons here because validity in theology (and generally in the humanities) is a topic that we discuss regularly in our discipline not just as a matter of proper method, but precisely because we are very much self-conscious of accusations of subjective bias, but which in science is often poorly articulated because of the insulated sense provided by the objective, mathematical analysis which is the hallmark of scientific rigour. Therefore science often seems to be less aware of the ontological struggle, precisely because of its effective capacity to not be trapped by the subjective critique.

criteria. This is a piece of meeting our goals as expressed in chapter 1.2 - Our Hypothesis.

It is worth challenging that the opposite position of this paper is exactly the idea that there ought not to be discourse between theology and science precisely because the two have incomparable epistemologies. Many theologians will acquiesce somewhat to this view and at best relegate theological and scientific discourse to the human elements of their influence on society (i.e. ethics). Obviously we feel this is unnecessarily limited, however it is difficult to disagree with some authors such as Robert Russell, and their position on the importance of this restricted level interaction, other than to say that it is perhaps overly restrictive. (Ventureyra, 2009)

3.2 – The Principle of Dialogue

Pambrun immediately follows the analysis of Lonergan with an application of Ricoeur to the problem.[29] As stated earlier we do not have time to delve into this aspect of the conversation, however we will say that Ricoeur highlights the limits of scientific methodology (epistemologically speaking) which relates directly to the role imagination plays both in theological thinking as well as scientific discovery. (Pambrun, 1993, pg. 115-117) In fact, when we discussed historical developments in cosmology, the formative role that imagination plays in the authenticity of scientific exploration was left implicit but no less palpable (recall Schroedinger's cat for instance). Suffice to say, from here Pambrun wraps up this initial

29 It would be interesting here to explore the impact that Ludwig Wittgenstein – his language game, and what constitutes language – as well as the cognitive and linguistic theories of Noam Chomsky, would have on our discussion. If only we had the *time and space* to explore this more fully. I am certain that both authors would add greatly to the popular applicability of the topic as well as adding to the credibility of our discussion with respect to its extensibility within secular circles. In fact, Vincent Brümmer's *Interpreting the Universe as Creation: A Dialogue of Science and Religion*, 1991, does explore Wittgenstein in this vein according to a book review by Pambrun. (Pambrun, 1994)

treatment of how Lonergan and Ricoeur can be co-ordinated so as to add to our understanding of science as a source of knowledge, and to generate a potential avenue for discourse between theology (at least in principle) and science, on the grounds of similar intellectual moments and motifs. We will address Lonergan's cognitive operations more closely, and in regards to scientists themselves, in chapter 4 – Constructing a Discourse, which will again address the role of imagination.

Pambrun continues revisiting Lonergan (and many other authors as well) throughout the intervening years, in many publications, from 1993 to 2015, all with an eye to generating a more comprehensive dialogue between science and theology. By 2015, Pambrun revisits the theme of his 1993 article, and significantly expands on it for a contemporary audience. This truly is a revisiting because in many ways this paper is a development from Pambrun's first one we mentioned. By this point observational astronomy and particle physics had made significant discoveries, clarifying much of what was still theory for the physical cosmology of the 1990s. As well, Pambrun is no longer suggesting that the texts of Lonergan and Ricoeur might be collaboratively applied in a mutual conversation with science, but instead this co-operative value is a given. He has even refined this further wherein he now differentiates explicitly on how Lonergan best illuminates the theoretical modes of science and Ricoeur the practical modes. (Pambrun, 2015)

The article does however begin with one very large concession from the 1980s and 1990s, there is no longer any pretence that science and theology might discourse directly. This is important because as Pambrun puts it, this is born from a ". . . modesty that comes with the understanding that the meaning of such notions as "truth" is informed by how these terms

function in relation to the meanings of other words in a context that relates answers to questions." (Pambrun, *Horizons*, 2015, pg. 97) This necessarily means that the notions of any given discipline are so tightly "bound to the methods of investigation that define those disciplines as distinct . . ." that effective communication is inherently difficult. (Pambrun, *Horizons*, 2015, pg. 97) Remember that in the 1993 article Pambrun commented on the frustrated state of communication, but did not explicitly advert to the very real conflicts of the day, this new statement not only acknowledges said conflict, but states that more or less such conflicts are mainstream. The exact form of what a successful dialogue would look like is still a matter for us to develop. Again, throughout chapter 4 – Constructing a Discourse, we will attempt to explicate its nature more fully. For now we must beg a little more patience as we work to engender its nascent form.

Interestingly, despite the article being an obvious development from his earlier referenced work, Pambrun's sources are not any more modern. This suggests that while the philosophical ground work may not have changed, it is possible if not likely that the contemporary social context (including Pambrun's own expertise) has in fact developed. Why this is significant is because it strongly suggests that over a thirty year period the public interest in the topic has reached a wider more conscious audience, which is exactly the sort of desire or need we suggested was of necessity. Equally, this lends credence to the idea that there are grounds to believe in a method that will respect the autonomy of theological and physical cosmologies as independent endeavours.[30]

30 Part of the reason for this confidence is that not only has a respected academic spent thirty years researching the topic, but that the beginning and end of this period are bookmarked by nuanced positions regarding the same interlocutors. This confidence is furthered by Pambrun's dedication for this article to William Stoeger, one of the theologian scientists that we will reference, indicating that the conversation is already existent if not fully formed. (Pambrun, *Horizons*, 2015, pg. 96)

3.2.1 – Progress Towards the Practical

On page 99 we are presented with the first clear, practical guidance with respect to applying our method. The second paragraph of the page outlines the social steps by which our method can be tested. First, is there an acceptance by the agents of the disciplines that in fact there is a mutual basis for communication? Inseparable to this is under what venue could this occur, and in what manner would be acceptable to both those directly involved as well as to interested onlookers.[31] Second, do the parties mutually recognise that their discipline is not in fact indefatigably isolated, as witnessed to by virtue of this common capability? Third, or perhaps an extension of the second, do the parties understand that philosophy as we have so far explored it, provides the means for this communication while still maintaining the independence of either faculty? It is, of course, Pambrun's contention that the answer to all three is "yes". The first step to proving this, however, is once again explicating the work of Lonergan on the topic. Specifically his acts of understanding; experience, understanding, and judgment, and more so our recurrent and conscientious recognition thereof. By taking Lonergan's words to heart, that:

> … if knowing is a conjunction of experience, understanding, and judging, then knowing knowing has to be a con-junction of (1) experiencing experience, understanding and judging, (2) understanding one's experience of experience, understanding, and judging, and (3) judging one's understanding of experience, understanding, and judging to be correct.
>
> (Doran, Collection, 2005, pg. 208)

Perhaps we will find an intellectual avenue on which theological cosmology and physical cosmology can have a meaningful and mutually constructive discourse, by first allowing that

31 I must thank my thesis adviser, Mark Slatter for pointing out in an early edit the incredulity with which the first may be met, and that it is not sufficient to presume these conditions have been implied within the first, nor subsumed by the third. It is no doubt a reality of our day in age that the popular sentiment is that science and theology cannot engage in meaningful intellectual discourse outside of the periphery of their respective disciplines (namely ethics and social impact) if even there.

each address in the firmest of manner, that which they know they know.

If we are in fact successful then we are told we should be able to account for three very specific questions. One, “What am I doing when I am knowing?”. Two, “Why is doing that knowing?”. Three, “What do I know when I do it?”. (Pambrun, *Horizons*, 2015, pg. 100) These questions are of course right from Lonergan's collected works, wherein he is exploring the difference between “scientific” sense and common sense, and the role of interiority. (Doran, 2017, pg. 80) It bares mentioning that even though much of this particular section of Lonergan's book uses scientific examples (as in properly speaking the physical sciences, i.e. physics) to distinguish common sense knowing from that of theoretical sense knowing; the book itself is about theology, and for Lonergan a science is often more generally meant to refer to what one would identify as an objective study of a thing. Pambrun clearly makes the point that if both the theologian and the scientist have authentically engaged with these questions that they will in fact be tacitly engaged in communication (if not directly with one another at least with one another's subject). We will also be putting this idea to the test in chapter 4 – Constructing a Discourse. Further exploration of this also highlights the demand that authenticity for a theologian of cosmology implies competence in a multitude of theological disciplines, culminated in a hermeneutical awareness of how cosmological themes have shaped historic theology every bit as much as they may have influenced scientific cosmology. (Pambrun, *Horizons*, 2015, pg. 108-109)

At this point we are once again directed to Ricoeur, however this time, as much as his earlier contribution stands, the focus is on the analogy of Ricoeur's hermeneutics to the process of technology or practical science. While this is a significant achievement, and for many likely a

more approachable concern, it is not rightly in the purview of this paper. However, it is still very much relevant to a form of cosmology. As you recall we mentioned some interpretations of cosmology specifically refer to the social and political horizons of the human condition, and it can hardly be denied that the past thirty years of technological achievement have shifted our sociological and political cultures.[32] (Pambrun 2015, pg. 111-112) This focus on Ricoeur is not exclusive however, as we recall the collaborative use of both Ricoeur and Lonergan is no longer an experimental idea but a strongly accepted suggestion.

3.3 – A Call for Self-Reflection

Now we must consider that by theology we cannot simply mean a Christian theology as a collection of knowledge, but rather a method of doing theology – in whichever cultural form – as a discipline just as there are disciplines in science. There are of course specific sciences, like the science of the stars (stellar cosmology) but there is also science which is simply the reference to the property of doing science in general. In this way, saying that theological cosmology can mutually inform physical cosmology so as to inform a theology of cosmology is just saying (though it is no small matter to actually do so) that together a more better efficacy, based on cosmologically existential concerns, can be worked towards.[33]

Pambrun explores the nature of such a discourse, albeit in regards to conflicts within

32 It is interesting to consider that perhaps Pambrun is alluding to our imaginative capacity to enrich collective efficaciousness through engineered solutions to perceived problems. In this sense, it is possible that there is a correlation between our capacity for greater sympathy/empathy and technological progress visa vis a moral obligation to improve our collective situation. This is more strongly explored on page 118 of the article in question, for those interested.

33 This is not contrary to our intention to focus on Catholic theology. For starters because we arrived at this place through Catholic theology, and we might not have given a different starting point. Further, even though this suggests a potential benefit from a theological way of thinking in general, we will still be using Roman Catholicism when it comes to exploring our practical examples (if again mostly out of brevity and convenience).

theological subdisciplines, with his 2015 article featured in *Theological Studies*. He quite clearly states on page 425, that while conflicts tend to arise from fragmentary discourses, an exploration of phenomenological and hermeneutical shifts in philosophy leaves us better able to address such problems. Continuing onto page 426, Pambrun highlights how Christian theology has a well documented understanding of how these conflicts develop and crystallise on an institutional and cultural level. Ostensibly, this lends support to our thesis, that theology has a unique (though not necessarily exclusive) competence when it comes to bridging gaps between related disciplines with seemingly disparate modes of reasoning.

3.3.1 – Beyond Hermeneutics

Of course it needs to be noted that this article of Pambrun's is about dealing with theological conflicts within schools of thought in the Catholic Church, specifically in systematic theology. However, should this mean it is a priori unusable for our purposes – especially as one might infer from our history review, that at least some of the conflict between theological cosmology and physical cosmology originates in the methods of our reasoning and perhaps not so much from an inherent discord of truths. Again the importance of Ricoeur's thought is principle (Pambrun, 2015, pg. 427) in the development of Pambrun's approach, and again we will ask that the reader accept this for the sake of brevity, especially as it pertains to the importance of hermeneutics in the search for understanding over and above such things as analytical philosophy. However, let us be clear that again we are not suggesting such a thing as the hermeneutics of human sciences be applied to the activities of physical science (in our case specifically physics) in anyway. Physics is very competent and capable of exploring that which

it is set to. Our issue is not the physics, but perhaps whether we can find a manner to communicate meaning, intelligibly and beneficially, between physical cosmology and theological cosmology. In this sense, it is not a hard task to suggest that hermeneutics is relevant at least in as much as it might be applied to the stories physical cosmology tells just as it is to the stories of theological cosmology. It is important to note that Ricoeur's hermeneutical approach is not sufficient on its own, even for Pambrun's concerns. As he puts it:

> We are left with an appreciation of the variety of disciplines and how they are part of a more general mode of reasoning (e.g., science or historical understanding), but the question remains: how do we relate these modes to one another?
>
> (Pambrun, 2015, pg. 435)

It would seem that Ricouer's thought helps to reinforce that there is independent value in our disciplines, even while we are exploring Pambrun's direction for a means by which we can make sense of these disciplines as interrelated, in his own words "... be this an intellectual, practical, or aesthetic mode." (Pambrun, 2015, pg. 435)

Pambrun continues with a rhetorical warning that serves to move us past the limits of Ricoeur, while firmly introducing Lonergan's thinking:

> ... all discourse is based on a fundamental desire to understand. However, simply alluding to our fundamental desire does not help us grasp how the distinct fields can communicate with one another. … To do this, I turn to Lonergan's notion of interiority and generalized empirical method.
>
> (Pambrun, 2015, pg. 435)

Once again this asserts that Lonergan supports an objective set of cognitional functions (experience, understanding, and judgment) that are a part of the act of knowing. As is further explained:

> ... experience is how we identify data; understanding is how we organize the data as an intelligible order of relations; and judgment is how we come to an insight into the relationship between understanding and data, such that we can affirm a truth with respect to the reality that shows itself in the data.
>
> (Pambrun, 2015, pg. 436)

However, this alone is not enough to bridge the communication divide between disciplines. He further suggests that we need to take into account Lonergan's idea of patterns of experience. (Pambrun, 2015, pg. 437)

Continuing with an exploration of using Lonergan's approach, Pambrun addresses *interiority*. A distinction is made between the typical self-reflection that one generally infers from the term interiority, but rather that we approach the issue as a cognitive exercise – one of ourself – as subject asking "What am I doing when I am knowing?" (Pambrun, 2015, pg. 437). Notably this is a question that focuses not on the objective truth of the results of one's study, but on the authenticity of the subject inquiry itself. It is certainly worth mentioning again, in no way will we be challenging the credibility or suitability of one discipline over another for their respective exploration of cosmology. In this sense, we would not interpret the above question as a challenge to the objectivity or validity of scientific inquiry in physical cosmology. We are, as ever, exploring how the above question could play a functional role in discourse between the disciplines in the case of theological and physical cosmologies. Still, we will come back to that in the next chapter, 4 – Constructing a Discourse. This is in keeping with what Pambrun argues for, wherein this practice of interiority allows for an acceptance of how a "specific pattern of experience" necessitates a difference in the character of one's modes of reasoning, since while:

> The same general pattern of operations is at work, but experience, understanding, and judgment will be dealing with a different kind of experience, a different kind of intelligibility and, hence, a different form of judgment.
>
> (Pambrun, 2015, pg. 440-441)

Thus it is that, in his words (and which is ultimately the source of our optimism in this paper), we can explore these differences as a matter of interiority, and on the basis of the commonalities of the cognitional operations, "explore in more detail a "model of complementarity"" (Pambrun, 2015, pg. 441). It is at this point which we will leave Pambrun's work; though the remainder of the article is quite interesting,[34] it is a practical (and highly particular) application of the insight we are looking to adopt, and as such not strictly speaking relevant to our argument's object, as we have set out to apply it to.[35]

4 – Constructing a Discourse

Accepting that we have now reviewed major developments in related theological and physical cosmologies, as well as having justified an essential methodological approach, it is certainly worth seeing how this can be formally combined to meet the aims of our proposal, in principle if not in total fruition. Essentially a proof of concept is the best we can hope to achieve in this paper... In part because of the obvious restriction of space, but more importantly out of two-fold modesty. The first part being that even if there were space to write an entire

34 I feel inclined to share a personal anecdote regarding Pambrun. While I was his student, during a graduate class, he once remarked that he was surprised to hear that I personally find the methods and writing of Karl Rahner more appealing than those of Hans Urs von Balthasar. At the time I found this perplexing, not because I dislike Balthasar's works in any way, but because I had very comfortably considered Rahner a particularly useful theologian in my studies. However, after reading this article, I believe I understand what it is that Pambrun saw, which lead to his surprise.

35 If the reader finds it difficult to follow the remainder of this paper, I would recommend you read the entirety of this aforementioned article. It may help to serve you analogically, purely as a matter of the process being abstracted from the content of inquiry.

comprehensive treatise on our topic, it would take far more research and experience than is reasonable to expect at the master's level. The second, and easily more important issue of modesty is that a treatise on the matter – from one expert, or even school of experts – would hardly be comprehensive assurance that our thesis is correct, let alone of functional use to all experts in their differently concerned disciplines. For it to be proven in the fullest sense it would need to be accepted by the audiences of both theological cosmology and physical cosmology at large. This would not merely mean read and taken as being essentially inoffensive to the sensibilities of either discipline. It would also require for it to be shown demonstrable appreciation through dissemination throughout the disciplines, while generating thoughtful input on both sides in the form of constructive dialogue. It would be nice to say that either condition could be met herein, but to do so would be nothing short of hubris, and even the consideration of such would just be a pretence. It is worth noting that this humility is consistent with our stated expectations in chapter 1.2 – Our Hypotheses.

4.1 – How Do We Know How They Know

In an effort to achieve as much as we can – our proof of concept – it is at this point worth reviewing the modes of reasoning in which theological and physical cosmology respectively engage. To do so we must explore some level of the independently authentic interiorities within which either of the theologian or physicist can find at once an acceptably self-identifiable description of their experience and also a reasonably inoffensive (to their understanding) description of the other's discipline. That is, both parties need to be able to recognise a description of themselves (as a doer and knower of their field of interest) in our expression of

their mode of reason, while also being able to accept the other's description as being anything other than disingenuous. It should be sufficient for either party to describe their respective interiority on their own, and for that description to be accepted by the other. Any lesser position would be tantamount to ignoring the application and principle of intellectual honesty; failing to meet this standard would frustrate our test case before it even begins. So then, how would we describe the modes of reasoning for both the theologian and the physicist, albeit separately?

Since this paper is an exploration belonging to the discipline of theology (no matter the broader hopes) and is not in dialogue with an actual physicist, it must suffice for us to explore the interiority of a proverbial physicist (through proper research of one's actual discourse) and thus engage with a simulacrum thereof. We do this in the genuine hope that an actual physicist can accept our humble description, even if only conditionally or marginally; perhaps with a feeling that they might constructively offer academic corrections or clarifications. At least in this sense we will have the beginnings of a conversation, and a position from which our thesis can be applied. In this spirit of optimism we shall rely on Roger Penrose's book The Road to Reality (which we have referenced earlier) as a comprehensive guide to a modern, well respected, voice in physical cosmology; one that is also conveniently replete with personal commentary.

4.1.1 – Faith in Reason

Let us first propose that at the foremost (for physics) mathematics is the language best capable of creating models which lend themselves to empirical predictions and study through measurement of phenomena. While this is not physics as a science, in and of itself, it is the methodological language par excellence for observational, computational, and theoretical

physics alike. If one were inclined to challenge this assertion, it is worth pointing out that the preface to Penrose's book revolves around mathematics, as do the first sixteen chapters! Still, we must be careful not to suggest that Penrose believes that physics' heavy reliance on mathematics is purely convenient and coincidental, any more than it being a special subset of mathematics itself. He repeatedly discusses the differences in attitude between which mathematical models are truly reflective of reality and which are merely convenient. All the same, it is fairly clear that Penrose ascribes to himself the disposition that physical reality subscribes to some specific, if not all or all known, mathematical models and principles. (Penrose, 2004, pg. 1033-1038) So then how can we say that the physicist sees the truth of mathematics and mathematical models in physical cosmology? If we quickly appeal to philosophy, Pambrun actually explicitly refers to Ricoeur's The Rule of Metaphor: Multidisciplinary Studies of the Creation of Meaning in Language, 1977, and specifically the section, “Study on Reference”, to build upon the importance that models play in science, separate from their otherwise deductive methods. It is difficult to put this any other way, so let us co-opt a quotation from Pambrun in reference to these thoughts on language and imagination; “In this sense, truth is ultimately metaphorical truth!”[36] (Pambrun, 1993, pg. 120-121) However, as usual, we do not have time to get into the details here, but rest assured that Penrose repeatedly references the use of imagination as a natural element for the conception of mathematical ideas. Page xviii of The Road to Reality offers just

36 It is again worth bringing up the potential future value of Alfred Whitehead's, Process and Reality (1990), specifically on the nature of mathematical reasoning.

This also alludes back to our mention of various interpretations of quantum mechanics, such as the classical Copenhagen interpretation, one could also look up the many-worlds interpretation, a comparison of these is a direct example of the necessity of interpreting mathematical models (and real-world scientific data) outside of the scientific method itself (though there is experimental work being done that is attempting to prove one interpretation over the other. In either case we will get back to the significance of these interpretations in chapter 4.5 – Modern Sensibilities.

one such example, the beginning of a trend that repeats throughout his references to new mathematical concepts, though by no means is this reliance on imaginative abilities restricted just to his use of mathematics. So then it seems reasonable, in a nutshell, to say that the mode of reasoning for a physical cosmologist is the imaginative use of mathematics. A rigorous, yet creative, effort to model phenomenological observations in a manner which can be effectively and numerically analysed, and whose predictions can be tested in a similarly observational manner.

4.1.2 – Reasonability of Faith

It is easy to think that the above description sounds nothing like the mode of reasoning for theologians. It is not supposed to, if it sounded like theology then we would have failed to put ourselves in the mind of a physicist. However, the very fact that we constructed this understanding of the physicist's mode of reasoning is proof that it is intelligible to a theological mind. However, we must still describe our mode of reasoning to a physicist. First in all things for a theologian, is faith. We have faith, it is the beginning of what we do as theologians, it is our experience. Of course beyond this there are innumerable methodologies at the disposal of theologians, which create conflict even in our own discipline. (Pambrun, “Conflict in Current Roman Catholic Systematic Theology”, 2015) One needs to be careful to distinguish between our sources of theological data and theology itself, especially with respect to conversing with science. Theology's relevance to science cannot be an assertion that religious texts offer scientific authority. Similarly theology must be viewed as a discipline, not simply a series of formalised professions meant to exemplar religious doctrine.

Here we need to revisit Saint Anselm, and engage in an especially succinct argument for the nature of systematic theology; theology is faith seeking understanding. What's more, our faith is informed by tradition, reason, and revelation. (*Catechism of the Catholic Church*, 2003, #158-159) In the case of revelation, it can be personal or authoritative (i.e. scriptural). When we speak of scripture, of course we are referring to the Bible; the Bible as the Word of God. *Word*, both in Jewish and Hellenistic traditions (Logos) is an expression manifested efficaciously, and it is impossible to argue that our biblical tradition is not historically rooted in Jewish and Hellenistic culture. The Word of God is therefore not to be confused with literary words in a reductionist sense, but is the action of God recorded as scripture. Therefore our faith is best understood by living our tradition, fully engaging our reason, and witnessing not to the literal facts of the Bible, but the efficaciousness of God's immanence in history – i.e. revelation. The question then, is this something a physicist can accept as reasonable and rational? To be perfectly honest, not in the realm of scientific exploration; but doing theology is not doing science!

The question, as we have been discussing it, is not whether scientists and theologians are doing things which can be combined in some simple, arithmetic manner. The question, is whether what a theologian does can be intelligible to a physicist, just as what a physicist does can be intelligible to a theologian. We must appeal the the human reason of the physicist and not the scientist personality thereof. In this regard, our mode of reasoning is something a physicist can accept as reasonable, not as a scientist, but as a human. The proof, as it were, is in the pudding. Many scientists, certainly those with an atheist bent, are particularly suspicious of the character of theology as a discipline. Generally this bias is about a popular idea in religious

thought, not what we as theologians would consider critical thinking in academia. There is really only one correction for this, and it has nothing to do with discourse between theological cosmology and physical cosmology. By engaging with scientists as people, and not specifically as professional identities, we can demonstrate what it is that theologians do in society generally as well as in academia. This could take any number of forms, from community outreach for social programs, to political activism for rights and the environment, things which appeal to the common human nature of all people. In these realms we have both every confidence, and a healthy track record, in the efficacious role that theology can play in the world. If we can demonstrate that our discipline has rational, effective, results in the world, then scientists as people will be more apt to accept our mode of reasoning (both in principle and in regards to our discipline alone), and thus more amiable to extending the courtesy and presumption of intellectual honesty which our thesis requires.

4.2 – What Are *They* Doing

If we now understand, at least in general, the mode of reasoning for both theologians and physicists, we should make certain that we understand the specifics of our physicist's interiority, the cognitional operations as they are manifested in the activities of our physicist subject. Thus far we have relied principally on Pambrun's exploration of Lonergan's works, in establishing some reasonable method for our discourse. However, at this point we will have to turn to Lonergan, unmediated (save through his editors), specifically through Collected Works of Bernard Lonergan: Insight (2005). This will actually serve us two-fold, first in the obvious way that it will or will not begin to confirm the basis for our thesis. Secondly, it will also serve as a

testament to the veracity of the universality of Lonergan's thoughts, by confirming that he managed to appropriate the interiority of the physicist mind.

As with all sciences, it is easy to say that the data being utilised are the carefully and consistently recorded observations of an experimentally isolated phenomenon. Another way to look at this definition is that, first and foremost the data are numerical measurements of a comparative change under consistent conditions. This potential change could be one of position, or perhaps time, in either case for a singular object or set thereof. However, it could equally be one of comparative difference, such as the size or light output of various stars. In this second case, the objects studied may necessarily differ in identity, but there is a presumption that they are of the same class of thing. As a matter of accord, the recording of some numerical value by some assigned rule, serves as the act of careful and consistent recording. Similarly, the comparative change (whether actual or potential) is the observation of a phenomena, while the consistent conditions provide for its relative isolation. It is tempting to presume that this may be a description of the experience in Lonergan's cognitional operations, but strictly speaking it is not.

What then corresponds to Lonergan's concepts of experience, understanding, and judgment in the case of a physical cosmologist? Here we could well run into a linguistic trap. It would be far too easy for the physicist to misappropriate what we mean by these words; we need to identify in their own language, that to which we are referring. Keep in mind that we are not asking the physicist to engage with their interiority (Lonergan would insist that a good scientist is already inclined to do as much, as anyone would for an intellectual exercise), it is us who are attempting to find common ground through an understanding of the physicist's interiority. So it

is that we must attempt to recognise our cognitional structure within the act of doing science – Lonergan himself refers to the scientific method as being a special case of his cognitional theory, in the sense that the latter is the more general (Doran, 2017, pg. 233) – and in a manner with which a physicist can relate. It is in that sense in which we will need to be careful to describe what we are referring to using the words of their discipline, and not our own, and with due respect to their mode of reasoning.

If we consider the basic scientific method – hypotheses, apparatus, observation, analysis, conclusion – as the essential operations of scientific inquiry, we cannot simply one-for-one substitute our cognitional structure with their operations, as some may be inclined to expect. They simply do not share equivalency. If we first remember that our model is cyclical, that it involves layers of repeated reflection, then we must choose a starting point (realising that this is perhaps arbitrary and can be explored both forwards and backwards through time). It should not be any surprise then, that elements of our model are evident in each of the stages of the scientific operations.

Hypotheses for instance requires some obvious level of judgment (by our reasoning), precisely because the scientist is proposing some sort of reasonableness in the recognition of a phenomenon they are choosing to make a study of. It is then obvious that there must have been understanding of some sort, with respect to that phenomenon, precisely because the phenomenon has been identified as an object to be studied. This in turn means there was a prior experience of the phenomenon, some perception of sense data. Similarly, developing an apparatus (whether speculative or real) for their physical experiment involves the cognitive process as well. So too will observation, and so forth. We will take a moment to review this for observations and

conclusions, just to drive home our assertion that there is not simply a one-to-one relationship. First off there is an experience of data; in the language of scientists, there must be a distinguishable set of changes, an identifiable variable to isolate. By measuring this variable, the physicist has effectively understood it, there is a value for the data and it is not purely an experience without context. Then there is an act of judgment, having recorded something, the physicist must decided whether and how it can be analysed via whatever appropriate mathematical process their analysis requires. Finally, there is an experience which begins their conclusion; their analyses has resulted in some discernable insight. This insight is then placed into some specific relationship to the original phenomenon, couched in mathematical terms – it is understood. Ultimately there is judgment, an expression of the significance of the insight gained through the analysis and its understanding.

This explains the cognitional operations of a physicist, but what about our own? Realistically, we as theologians do not need to translate our method in a similar way. Principally this is because our method in its most generic form is already synonymous with Lonergan's cognitional operations. Still, especially in the context of discourse with other disciplines, we need to express the action of these operations explicitly. Of course any given theologian would already outline a more particular method for a particular inquiry, this is something we need to do regularly in our discipline – recall Pambrun's article on conflict in theology (Pambrun, *Theological Studies*, 2015) – even when addressing other theologians. The scientific method, however, is already a very specific expression of methodology. The object of inquiry may change, as may specific techniques, but the method itself is not essentially unique for each individual inquiry.

4.3 – Authentic Interiority

At this point it is appropriate to say that we as theologians can certainly accept this depiction of a physicist's interiority (with the understanding that it was written by a proverbial physicist and is thus provisional on the acceptance by an actual physicist). Not simply as a matter of their de-facto self-authority to describe their own actions and intent, but as something the theologian – as an outsider – recognises as a genuine exploration of the physicist's interiority.

In turn, this discourse on interiority and authenticity has lead us somewhere useful, if the theological cosmologist and physical cosmologist mutually appropriate these descriptions, as a matter of sympathetic collegiality. Presuming so, then they can also engage with each other's subject matter; not as their own, but as the other's, and thereby perhaps recognise outside concepts, ideas, or truths as relevant to their own discipline. If this is possible then we can offer constructive input, which is to be judged by the receiver through appropriate application of their cognitive process as shaped by their unique mode of reasoning. In short, we will have proved our thesis in concept.

William Stoeger was a Jesuit priest and theoretical physicist for the Vatican Observatory. In a paper on the topic of modern hermeneutics and the use of scripture, Pambrun made reference to the numerous works of Stoeger's on the relationship between modern science and theology. “The dialogue between science and faith has become one in which questions are based principally on the findings of modern science.” (Pambrun, 2000, pg. 156) In our modern times, the conversation is essentially one-sided; science has proved itself both as a challenge and corrective to modern theology. In itself this should be no real surprise, our reason being one source of revelation, and science being an undeniably excellent exercise in reason. However, as

we have discussed, and as is certainly inline with the thinking of Lonergan, scientific[37] knowledge cannot simply be viewed as the superior knowledge, regardless of its role in our culture.

With the above in mind, and with the application of everything we have discussed with respect to Lonergan, what impact does it have on the cosmological knowledge we have garnered through history? The science of it – the physical cosmology itself – we have discussed, albeit in a general way, with respect to the impact specific scientific discoveries had on popular theological ideas of the times. But what if we look at what a theological exploration of these discoveries might reveal? Could it have influenced the past, or more importantly could it impact our current world for the better?

If we as theologians approach each topic, considering our interpretation of Lonergan's method as applied to physical science, are there any acceptable insights we might offer? Regardless, we must first remember that there are things we cannot do; principally we cannot challenge the mode of reasoning which is representative of what makes physical cosmology its own discipline. But we can challenge the individual cognitional moments. Furthermore, if we are to be authentic, and given the inherently deductive nature of the middle three operations in the scientific method, it is unlikely that we will discover much in the way of theological influence therein. In this vein, we can exclude an explicit explication of proverbial apparatus, observations, and analysis, if only with the assumption that they are inherently logically derivative steps based on phenomenology. Of course this does not leave them unassailable to a theologian's critique, providing that critique is grounded solely on the rules of phenomenology

37 Recall our earlier mention of Lonergan's academically traditional use of the word science. Here we are using it in the popular/proper modern sense of the hard sciences (i.e. physics, biology, chemistry, etc.).

and mathematical analysis. However, this would be a matter of logic and not theology, and thus any intellectual could assail them in such a matter. Even more so, if they were to fall to such a critique, it would be proof that the responsible scientist was inauthentic with respect to their interiority, or from the perspective of scientists, that the science in question (as a product) was simply invalid because the application of scientific process was flawed. In all honesty, this is exactly the sort of thing that scientists are on the lookout for during their peer-review, just as our own peer-reviews watch for inauthentic/invalid theological processes and reasoning. Still, this does allow us room to explore the cognitional moments involved in both the hypothesis and conclusion elements of the scientific method, and thus the potential significance of theology at both the beginnings and ends of scientific inquiry.

4.4 – Appearances Matter

The heliocentric solar system (the first of our scientific discoveries chosen; chapter 2.1 – The Heart of Division) as we discussed, challenged the central position of humanity within God's creation. It challenged our primacy as the paragon of God's objects of love. Or did it? Of course it certainly was seen as such a challenge; if we were not the geometric focus of all of creation, then how could we be any different than the rest of it. It also more generally challenged the use of our perception of the natural world order as a representation of divine natural law.[38] Similarly, Kepler's discovery of elliptical orbits challenged the notion of God's perfect creation. These are theological challenges brought about through reason when one considers the scientific reality of the cosmos. But again, is there anything theologians can say regarding the physics;

38 Here we added the label “divine” so as to be clear that we mean the theological concept of natural law and not the “natural laws”of science, such as universal gravitation.

remembering that it is not for us to challenge the method or content of the science itself. And so we must only engage with the cognitional moments of experience, understanding, and judgment, involved in the physicist's work, this is where we may be able to offer some useful input.

4.4.1 – A Place for Wonder

It is here where we will be engaging in some speculation, as we will not be going back to the original publications of many of the scientists themselves, but just the popularisation (though scientifically valid) of their ideas.[39] The *experience* that was no doubt the beginning of Galileo's discovery is one in the same for many an amateur astronomer today; an awe and curiosity about the population of the heavens. The acknowledgement that there is a vast body of things above us, unreachable yet present (if only to our visual senses). This of course leads clearly to an understanding that these are things which can be observed, and consequentially a judgment that they are worth observing. A professional scientist could very well give you their own version of these moments in their life, a description of their inspiration, the "why" of why they engaged with astronomy. Most, it is worth speculating, would express this in terms of wonder... A great, palpable, sense that there is significance in the awe they feel when faced with the vastness of their perceptions. The awe of the cosmos; Carl Sagan's Contact, whether the written or film[40] version, explores this all too human condition. (Zemeckis, 1997) Is this not the same sort of awe that nearly every one of us feels as a theologian when we contemplate the grandeur of God? Do we not each marvel at the exceptional content and quality of His creation?

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39 Ultimately this paper is not interested in the particular insights which theology might offer, but in the idea itself that theology might offer insight. Far greater depth and discourse would be required to claim my appropriations as authoritative, but all the same they should stand up as reasonable suggestions for such a greater effort.

40 Interestingly Sagan's story references Ockham's razor as a scientific principle rather than its original theological context, despite that it is posited to a theologian by a scientist.

Perhaps somewhat less ubiquitous in the case of Galileo, was the *understanding* which he intellectually shared with Copernicus; that the heavens were ordered, that a catalogue and predictions about their behaviours were possible with closer study. Certainly this was not unique, the heavens have been studied by civilisations around the world since time immemorial. However, these men in Christendom set about making a science of the heavens, a modern astronomy, the organisation of stars. Of particular interest, in our case, is their idea that what we know as our planets could have their positions mapped and movements predicted. This too is something theologians can understand, most notably, because these men were not working out of pure academic curiosity, they each approached this position as men faithful to the Church, and looking to expand on the body of knowledge on which the Church had a capital. They sought to expand the human understanding of God's creation, a very theological notion.

And now if we may look at their *judgment*; there was some import to their efforts, a meaning and purpose beyond the fancy and sanctification of their curiosity. It is doubtful that any of these men thought that the fruits of their work would result in technical gains for humanity at large. At best, they felt they could improve the calender of the day (controlled by the Church) and therefore positively impact the practice of farming.[41] Certainly no one was envisioning the creation of GPS satellites, harnessing radiation, protecting us from meteor impacts, or travelling into or through outer-space. Nonetheless, these men undoubtedly felt there was practical and religious value in understanding the heavens, predicated on the theological norms of the day. All three of these cognitional moments represent only one step in the scientific method as it pertains to the work of Galileo; his hypotheses, – the experience, understanding, and

41 This desire to improve farming practices is speculation on my part, meant simply as an allusion to the contextually obscure relationship at the time between intellectual understanding of the world at large and any ability to positively exploit this understanding for specific purposes. Though Copernicus' observations were the basis for the, as of then new, Gregorian calender.

judgment, that went into a single intellectual speculation.

We can continue exploring the cognitional moments of Galileo's next steps in the scientific method – which of course Galileo was not actually following in a modern sense, and which we are using purely as an intellectual exercise – as an analogue for the general doing of science.

4.4.2 – The Very, Very, Good and the Very, Very, Bad

When we discussed the discovery of the heliocentric nature of our solar system we also alluded to the impact this discovery had. In part this impact was due to the perceived conclusions of Galileo's and colleagues' science. Let us review some of these, in light of Lonergan's thinking, and perhaps recognise what theology has to say about them. First, Galileo's assertion of the realness of the Copernican heliocentric model is contrary to the Bible's creation narrative. This is where the "bad" trend in the theology we mentioned earlier comes into play. At this point in history, biblical literalism was largely rejected by theologians of the day. It could actually be suggested that the acceptance of biblical literalism owes itself to the political expediency it provided in the trial of Galileo. In this regard the Church certainly holds some responsibility for its role in both the repression of Galileo's science and also the spread of bad theology. But at the same time, it is inauthentic to ascribe scientific repression to theology in general. The fact that theologians of the day recognised that biblical literalism was inauthentic to our faith – despite the fact that it garnered increasing support, and arguably spent a few hundred years as a new norm – is proof that our discipline is fallible, but also that it is capable of being self-critical, and that it is not inherently hostile to scientific thinking.

Still, it is in the fact that Galileo argued that his notions were supported biblically, where he increasingly found himself in trouble. It was essentially an act of challenging the authority of the Church, and in particular the Pope (and even more so by insulting the Pope). (McMillan, pg. 78) Again, it can be argued that theologians of the day supported and defended Galileo's initial scientific discovery, until he made it especially impolitic to do so. This certainly does not prove that theology is of value to science; it equally does not prove the superiority of scientific reasoning, as it demonstrates that science is not an inherent corrective to theology. Galileo's defence (in this case) added nothing to the scientific credibility of his discovery, just as it did nothing to correct a particular flaw in theological thinking. What is even more important, however, is the conclusion that somehow a heliocentric model of the solar system somehow compromises the notion of humanity's primacy of place in the order of creation. Science as a body of professionals has no authority, in any manner, to make this claim on a scientific basis. There is no science that tests this, nor which affirms it, it is a conclusion based solely on the incorrect application of theological thinking to scientific discoveries.

The fallacy is that such a scientist presumes that the theology surrounding the primacy of humanity is based on the natural order of the world. Since this is not so, it is such that simply proving the natural order to be different than theologians think it is, is insufficient to suggest that one has inherently disproved the conclusions of said theologians via a simple matter of contradiction of truths. Furthermore, an argument from the basis of science against the primacy of humanity is not a justification for refuting the dignity of humanity in creation. That is, we cannot argue from the place of our existence in the solar system that we are somehow of no greater significance or import than any other thing in the universe. Scientifically, one could

reason that any atomic particle is only as important as any other atomic particle, inasmuch as one such particle could be exchanged with the other while resulting in no discernable change in the state of a system or systems. (French, 2015, s. 4) The extension of this could be that we as tiny, insignificant collections of atomic particles, cannot be deemed more important or significant than other such collections elsewhere in the universe. Beyond the overly idealistic notion that this could be true – say there is another identical "me" somewhere else; that would act the same as the "me" I am, if we instantly traded places – the reality is that this is not our human experience.[42] There is something about all of us that understands we are significant, even if we hold a very minor physical role in the universe as a whole. Consider the words of Carl Sagan, penned in response to the image of Voyager I looking back at Earth in 1990:

> On it everyone you love, everyone you know, everyone you ever heard of, every human being who ever was, lived out their lives. The aggregate of our joy and suffering. The thousands of confident religions, ideologies, and economic doctrines, every hunter and forager, every hero and coward, every creator and destroyer of civilisation, every king and peasant, every young couple in love, every mother and father, hopeful child... every saint and sinner in the history of our species lived there. On a mote of dust, suspended in a sunbeam...
>
> (Sagan, 2015)[43]

To repeat ourselves from earlier, good science is good reasoning. If science and theology contradict each other the fault is not necessarily in the science but maybe in our reasoning. This is not an impugnment of theology and certainly not of our faith, because, if our theology is faith seeking understanding, it behoves us to apply our best reasoning to the understanding of our faith. This means that theology necessarily develops along with our sources of revelation, just as

42 This is sometimes explained as the "teleportation" or "duplicates" paradox.

43 If you do not recognise the quote, I would recommend you watch the video. Realise that the image is inspired by a photo taken by a human construct that has travelled further than any human in history. A photo of a pale blue dot.

our understanding develops along with our reasoning. And so it is that even if Galileo's observations demonstrate that we are not the geometric centre of creation, we are no less a paragon of God's love. It is our faith, not our theology that recognises humanity's primacy in God's creation. In fact, if we are just one small civilisation on a pale blue speck, orbiting an unremarkable star, in a vastly populated universe that is mostly empty (and frankly hostile), is this not more assurance of our importance to God? If all of creation has purpose than ours must be special, if for no other reason that that we are unique in a cosmos that otherwise treats us as statistically irrelevant to the order of the cosmos as a whole.

It is also worth noting that at the time, science was not a discipline the way we think of it today. It is reasonable that many secularists would argue the premises which we ascribed to theologians are generally ascribed to by scientists; perhaps they would even argue that they are somehow the intellectual property of science, or at the least that a theistic position is not necessary for ascribing to them. Regardless of these arguments, at the time of Galileo, these were theistic ideas, intimately connected to the theology of intellectuals of the day, if only because there were no other academic disciplines for them to belong to at the time. If nothing else, we should be honest about the roots of our thinking; even more so if there are modern examples of similar theological influence, as then we have evidence of a trend which may even be essential, and thus provisional proof of our thesis.

4.4.3 – The Natural Order

In chapter 2.2 – What is Real, we mentioned Newton's universal laws of motion (specifically in relation to gravity), and again, Kepler's elliptical orbits. This was in regards to

the realness of mathematical models as they pertain to physical cosmology, as well as nominally linking it to God's action in the universe. It is safe to say that Newton and Kepler had a similar disposition to Galileo when it came to the role of mathematics and reality. Consequentially, it is probably safe to say that their cognitional moments with respect to their scientific endeavours were equally comparable. Specifically, it is undoubtable that the cognitional moments resulting in their hypotheses (with regards to celestial motion) were that mathematical analysis would lead to proof of consistent, predictable motion. What is more notable about Newton's discovery, as we mentioned, was that it resulted in a mathematical formula that seemingly applied to all objects in the heavens, and on Earth; it was not independently unique to each of the objects being examined.[44] We have already understood that at the time it was a ubiquitous idea that God had ordered the universe, in a way similar to how we might order a shelf; everything placed in a specific, intentional spot. However, Newton interpreted his laws as meaning that God also intentioned their movement as part of that order, that God created a universe that was inherently dynamic, governed by an intentional and discoverable law for motion. As we mentioned, this removed the necessity of God being involved with every motion in the heavens. As with Galileo, Newton felt it necessary to invoke God as a justification for the existence of the order of the universe, in addition to the maintenance of that existence. (Janiak, 2016) Of course one could dismiss this as a failure on Newton's part to idealise scientific reasoning. Perhaps he simply did not see far and clear enough to realise that God was an unnecessary contrivance, an intellectual crutch. Of course one can easily claim that Newton's conclusion has nothing to do with his science itself – that his science (properly speaking) simply proves universal laws of motion – and

44 Newton's law for universal gravitation does involve variables for the masses of the objects in question, as well as their distance from one another; what is significant, is that there is not a different equation for each set of objects, you simply need to know the mass of the objects involved and their relative distance apart. (Penrose, 2004, pg. 390)

they would be correct. But the corollary of this is that Newton's science also suggests a clock-work universe (at least until one considers the impact of quantum mechanics), which poses its own scientific and theological problems.

While Newton's laws arguably preclude any need of God interacting with the universe's operation, they do not in anyway add to the intelligibility of the origin or reason behind the nature of the cosmos itself. Further, even if clockwork precision were the reality of the cosmos at large, it would not explain our experience of freewill. Of course there are idealistic scientists exploring how a sufficiently complex system could manifest apparent if not actual self-awareness, and thus apparent if not actual self-determination; but in all honesty Newton's work does not predict or imply, let alone support, such an expectation. This in turn begs the question as to whether self-determination as a result of a complex clockwork is any more than extra-scientific wishful thinking than that of freewill based on divine design. One could continue to argue that if freewill is considered a verifiable phenomenon, that it is proof that there is more to the universe than a clockwork functionality. It would then be tempting to suggest that science, which searches for rational explanations, is simply missing a necessary rational (and a priori some insight or data that would provide it), without ever needing to accept a divinely prescribed notion of freewill. However, while the discovery of quantum mechanics may have provided a fresh avenue for such a discovery[45], in the two centuries between Newton and modern physics, it can be argued that atheist scientists gave up on such a pursuit (if they were ever inclined to engage in it).[46] The point being, that theological meaning played a direct role not only (though

45 There is a lot of popular literature (written by scientists and others) that speculate on the role of quantum mechanics on our consciousness. (Ball, 2017) Lest this be dismissed as merely speculative science as popular entertainment, one of Penrose's books is referenced in the above article, and this same book is referenced as a source in A Road To Reality. (Penrose, 2004, pg. 1072)

46 Strictly speaking this is an argument to made in another paper (which I am certain it has been), bringing it up only serves as an exploration in logical consequences and the nature and complexity of its existence as a

perhaps only nominally) in the origin of Newton's discoveries, but it also played an undeniable role in moving us past the seemingly incorrect postulates that it engendered.[47]

4.5 – Modern Sensibilities

By the birth of modern physics it was no longer necessary to appeal to theological thinking in regards to the role of mathematics as a reflection of the real (as discussed in chapter 1.2 – What is Real); by this time both theologians and scientists could be said to generally subscribe to this idea as an inherent quality of the universe. Of course there are still arguments about exactly what it means, and exactly who's idea it is (the theologian/philosopher's or the scientist's). The fact remains that it is culturally a generally accepted truth. Undoubtedly this adds to the sense of objectivity ascribed to science, after all it is still the primary user of mathematics in the representation and understanding of reality. A consequence of this is certainly that there is a change in the character of the cognitional moments, at least in how a modern scientist would self-identify them. There is no longer a need for, or explicit disposition leading to, a theistic assertion about the experience, meaning, or judgment behind the construction of a hypothesis. An experience of wonder is a symptom of the curious human mind, it does not have to be divinely inspired. The meaning behind that wonder is perhaps as simple as science for science's sake, or perhaps more altruistically, the desire to make things better through the understanding of a problem. Similarly, the moment of judgment can be as simple as, this experience is unexplained through current science – or even the more prosaic, that it could be

discussion is not part of our attempted proof. However, once again the reader may well wish to review the arguments of David Hume and Immanuel Kant.

47 We could get into whether this is a valid result of theological inquiry or just an accident of history. However, it is not our intention to delve into every rabbit hole. Suffice to say that if such a efficacious values continue to be seen as a result of theology as a social corrective, then it has proved its validity.

understood more precisely.[48] However, do these reasons really capture an authentic understanding of a scientist's mindset? If not, perhaps theology still has some insight to offer.

4.5.1 – The Devil Is In the Details

Einstein's wonder at the natural world was undeniably focused on the transcendent, something beyond the human self. In such cases, there is still a value in theology, if only because such expressions are part of our discipline's natural language. When Einstein purportedly said, “I want to know His [God's] thoughts, the rest are details.”, regardless of what his point was to fellow scientists it is our study of theology, and the hermeneutics therewith, that allow us to delve into the meaning that lead to his choice of words. Did he mean to invoke a creative consciousness that intended the whole of reality (God in some classical theistic manner or another), or was he merely invoking the colloquial expression of ultimate cause, meaningless outside of its effect, and simply meant as a reference to the wholeness of cause and effect (perhaps God, but at most in the sense of Spinoza). (Kung, 2005, pg. 105) While we could unpack this, it suffices for our argument that science (and certainly not mathematics) is obviously not always the choice language for scientists (if only when they are explaining rather than doing science). The significance of this should not be lost, just because a scientist uses theological or philosophical language does not mean that they themselves are a theologian or philosopher. It does not necessarily mean that they are effectively expressing their meaning, nor understanding the concepts behind what they say with respect to what they mean. This applies equally to ourselves. There are no shortage of examples wherein reasonable people misappropriate the

48 Recall our comment on the precision of Newton's theory of universal gravitation, again in chapter 2.2 – What is Real.

language of science, thinking they are expressing deeper meaning when they are in fact confusing one thought or concept for another. Certainly even scientists can recognise this. In this regard theology is of use if not for understanding physical cosmology itself, then for understanding the physical cosmologist his/herself. And of course it is this self which is in keeping with the cyclical nature of Lonergan's seeking authenticity.

4.5.2 – A Rose By Any Other Name

Of course we can continue exploring the cognitional moments as we have, in trying to understand the impact and insights of modern physics. Still referencing our earlier exploration in chapter 1.2 – What is Real, the discovery of quantum mechanics blurred the exact sense of what mathematics is to the reality of the cosmos itself. Other interpretations of quantum mechanics aside, one of the varied interpretations of the realness of quantum mechanical mathematical models is that of the many-worlds theory. In its most simple form, it suggests that since each and every solution to a quantum mechanical wave function is equally possible, and only known to be true once witnessed, we should view each of these solutions as potential real worlds. (Penrose, 2004, pg. 786-806) What is more, some even speculate that *all* of these solutions are real worlds; that our realisation of one such solution is indicative of us existing in one of those potential worlds, whereas some other respective "us"es are realising the other respective solutions in their respective worlds. Penrose actually dismisses the many-worlds theory, not outright, but in no uncertain terms. (Penrose, 2004, pg. 532)

Is there a role for theology in this cosmological discussion? Let us first be careful not to suggest that theology can answer whether or not these other worlds are real (as much as we may

be personally tempted to do so). As a scientific theory, it is up to science to determine if it is proven or not in accordance to their modes of reasoning (if it is provable, of course). However, we can certainly have something to say about the results, and the theologically cosmological impact thereof. Consider for a moment if there are an infinite number of "me", each in their own world of possibilities. Am "I" just "me" or am I a collection of "me"s? If so, am I morally responsible for just "me" or for all "me"s and their possible moral situations? We could write this off as fantasy, and it is certainly not worth spending pages exploring (in this paper, nor likely in theological academics generally). Still, it is every bit as real of a concern (if the theory were to be proven true) as theological discussions about whether I am morally responsible for something I have no memory of, or something that did not involve my free will. In either case, the significance as to whether I am "me" or a collection of any or all "me"s is directly related to the impact that one me's actions have on the potential for another me's situation (especially if I am now scientifically aware that my choices will affect, and have been affected by, other "me"s).[49]

4.5.3 – Deus Ex Machina

There are still more elements of quantum mechanics which involve theological interests. We mentioned in passing (in chapter 1.2 – Our Hypothesis), Polkinghorne, he has a particular interest in the significance of quantum mechanics. Specifically, he has reflected on how the mechanical nature of a classically physical cosmology changes our appreciation for God's action in creation. The Newtonian cosmology, or at least the popularised atheist interpretation thereof,

49 I suspect that the arguments around the classic reality machine could be of some insight both into the significance of this problem for the sake of argument, and also as a matter of speculative theology in the realm of science-fiction that could well become known as science fact. Certainly enough philosophical and theological energy has been spent analysing *The Matrix*. (Wachowski, 1999)

requires no involvement by God in the operations of the cosmos as a whole. In fact, such an involvement is often characterised as the definition of miraculous in scientific terms. In this way, scientists would be well justified in looking for "breaks" in the natural order of cosmological operations; in the hopes of proof that God has or has not reached in to interfere. It seems that this is an obvious theological fallacy in its own right, if only because there is no reason to speculate that God as an omnipotent being would "break" His own rules for the operation of the cosmos just to influence it. Would not such a being be perfectly capable of creating a world wherein His influence would not disrupt the very order He set in place? Or, could He not simply choose to act in such a way as to not be overtly disruptive of that order? Polkinghorne suggests that quantum-mechanical phenomena may be just that action, or if not that action on the whole, maybe the field in which God acts without breaking reality. (Merali, 2011) Could scientists test this? Can science determine the difference between what is divinely intentioned from what is apparently random, inasmuch as neither follows a mechanical rule, perhaps?

If experiments could confirm that sometimes unrelated, and otherwise random effects skewed towards results that were not distributed according to the otherwise proven statistical expectation, then maybe this would be evidence of divine intervention.[50] The more unrelated these effects were, the less likely that the skewing would be indicative of us simply missing some scientific insight that would otherwise lead to an explanation. In the meantime however, this seems more like an argument for a God of the gaps then it does a mainstream conception of God's action in the universe proper. Especially so, as the action of an imminent God engaging in

50 Again, this is just to serve as a logical extension of a thought, and therefore in the context of this paper is not being explored fully as such fullness is not necessary to prove our thesis in concept alone.

His relationship with humanity. Basically, it seems like a rather convoluted way to stay invisible in plain sight. Which itself seems contrary to either the idea of God's imminence or else His relationship to us.[51]

4.5.4 – Creation Ex Nihilo

This brings us to our last exploration of scientific discoveries of cosmological importance, and still related to Einstein's work, the Big Bang. It is generally accepted that Einstein's God is not the God of mainstream monotheism, let alone Catholic Christianity. Nonetheless, as discussed in chapter 2.3 – It's All Relative, the Big Bang is generally referred to as the moment of creation. Some scientists would vehemently prefer to refer to it as the beginning of everything, not wanting to allude to an act of creation, or even the idea that it occurred in some moment of time. Their principal point being that the Big Bang as extrapolated from Einstein's theories suggests that not only matter, but space, and more shockingly time, all began some 13.8 billion years ago. (Kung, 2005, pg. 11-13) So while we can suggest that the universe is a finite age, we cannot suggest that it began in a moment of time, because the concept of time as we know it is meaningless prior to and up to the effects of the Big Bang's inflationary period. There is a lot of conceptual physics here, the crux of it being, that according to many physical cosmologists, it is senseless to ask where the Big Bang came from, because there was

51 This last is a personal assertion which is obviously not proper to flesh out in this thesis. However, purely out of a desire for self expression, my conception of this critique is that it revolves around the idea that if God hides his action in the realm of quantum mechanics, then one might suggest His action is not imminent insomuch as quantum mechanics to our understanding does not govern the effects which constitute the reality of our daily lives. Such actions hardly live up to the miraculous character of a burning bush. However, if one were arguing that our concept of God's imminence is not frustrated when hiding His action in the quantum mechanical world, then is such a God really acting in such a way as to be in a personal relationship with us? We do not readily witness quantum mechanical events, in fact, according to science we cannot ever witness the happening of such an event at all – just the state before and after; the implication of cause and effect. How can we be said to be in a relationship with a God that chooses to keep His actions (if not simply His reason) fundamentally unintelligible to us?

no “where” in our sense of meaning, just as it is senseless to say what happened before, as there was no temporal sense of “when” as we know it.

So then what (quite literally)? What was the state of the cosmos before the inflationary period of the Big Bang, as close as we can get with science to that moment of birth? Science would say that we can observationally only get so close to the beginning, and even if we can get closer theoretically, there is still a limit. However, in both these cases, the closeness we are talking about is during the state of the universe after the laws of physics as we know them. If we try to theorise earlier than the fundamental laws of physics our understanding completely breaks down. (Halliday, 1993, pg. 1300) Perhaps here, if again only because it is the only tool we have, it is worth turning to theology for ideas. Still, caution and humility is required. One could argue that we are dangerously close to engaging in an argument for a God of the gaps just as we did with Polkinghorne, but there is a difference. To our scientific understanding, it is possible that the insights we have relating to physical laws could lead to a principal that governs even these laws as we know them. However, even this would have limits. For starters, there is a point in history where we cannot possibly see.[52] Anything earlier than that cannot be tested using our current observational technology, even in theory. Still, it is possible that we can speculate with some scientific validity through experimenting in the recreation of what we think the initial states of the universe may have been. (Yale University, 2010) If we were to suggest theology as a source of understanding these limits, it would need to be restricted to before the furthest moments for which we can conceive of relying on physics. In this sense, we would be engaging in cosmology in some manner which is similar to what we did before the birth of physical

52 We mean this literally in the sense that by looking further away into space we are actually seeing what was earlier in time, this is a consequence of light's limited speed. However, there is a theoretical moment in time where the universe did not allow the transmission of light because it was so dense. That moment represents the earliest possible moment that our telescopes could possibly look back to. (Zeilik, 1992, pg. 486, 491, 503)

cosmology as we know it. Where our humility must again play a role, is that this time we know the sorts of mistakes we made up to and around the time of Galileo. All the same, science would not be inclined to suggest what we are doing is useful, after all they would have no way of being involved, except perhaps, if we establish a conversation at the liminal moment in question. Part of this conversation would need to be agreement by both sides, to give and take intellectual authority as either side makes rational gains. Of course this is a grand speculation.

4.5.5 – The Known Unknown

There are other observational limits in our cosmos. As an effect of the expansion of the universe, and the limit of the speed of light, there are already parts of the universe which we will never see because the light from them will never reach us (no matter how fast we travel towards them – up to and including the speed of light that is).[53] (Zeilik, 1992, pg. 494) However, unlike the beginning of the cosmos, we should be even more cautious about relying on theology for speculating about what is beyond the cosmic horizon. For starters, in principle we can see and thus investigate the cosmos up to this limit (though this limit will continue to move as the universe expands, but likely too slow for human exploration to have to deal with). In this regard, coupled with our understanding of the universal nature of physical laws, there is no reason to speculate that that which is beyond our horizon is essentially different from that which is within it, as such our science should be every bit as accurate about what lies beyond as what lies within. There is no guarantee, of course, but we should just as well respect the insights of physics insomuch as they have thus far proven themselves.

53 Warp speed as per Star Trek would be a wonderful human achievement, and a grand scientific tool, wormholes too, may be a caveat to this otherwise real limit. However, regardless of theoretical speculation, there is no real practical science behind either option that would offer us a technological solution.

Speaking of the Big Bang brings up some similar concerns to quantum mechanics, specifically regarding the multiverse theory, sometimes referred to as the many-universe theory, and sometimes also referred to as another many-worlds theory. With the obvious linguistic connection, it should not be surprising that people sometimes conflate the otherwise different conceptions of many-worlds in quantum mechanics with that of many-universes in the origin of the universe. There are variations on the nature and creation of these other universes, whether they were born from the same event as the Big Bang, or are the results of black holes. (Penrose, 2004, pg. 761-762) Regardless, Kung rightly points out that how many universes God may have created (or continues to create) plays no bearing on any mainstream theological concept of God (it could certainly be argued that a multiverse is nothing more than a larger scoped universe). More importantly Kung dismisses the theory as almost trivial (Kung, 2007, pg. 146), a fanciful thought by a small minority of scientists, not likely testable in any real fashion and thus not necessarily belonging to science. However, like us, he ultimately admits to leaving it up to scientists to decide what is or is not of physical cosmological interest. (Kung, 2007, pg. 62-68) All the same, the idea of a multiverse – especially one which could lead to a similar multitude of "me"s similar to our original many-worlds discussion – leads to the same theological discussions as we have already covered.[54]

54 There is one exception to this, and that is the idea that a multiverse somehow supersedes the philosophical issue of cosmological fine-tuning. (Kung, 2007, pg. 68-69) I have consciously chosen not to address the this topic for a single double edged reason... Thus far we have spoken only about the proven contributions of physical cosmology and the thinking behind them. While some theologians use fine-tuning as evidence of God's divine plan, unlike quantum mechanics which is a functionally practical, accepted, theory which happened to disrupt the culturally accepted theology of the day (while also presenting new horizons), fine-tuning and an appeal to a multiverse are purely speculative discussions on the part of both disciplines. Perhaps relevant over all, but with rather low stakes; thus not very constructive to the model of discourse we are proposing. Kung likens at least the scientific part of this to "discussing how many spiritual beings could stand on the point of a needle." (Kung, 2007, pg. 67)

4.5.6 – The Unknown Unknown

This brings us to one last consequence of the scientific understanding of the Big Bang. What will happen after? For starters, humanity as we know it will be unlikely to exist; certainly, if science is correct, we will not be living on this planet.[55] The more practical theologian might well say that this is then irrelevant to our discipline. Perhaps it is, if we consider that whomever our descendants are at that time, they will not be essentially human as we see ourselves, and therefore will not be in relationship with God (or possibly even our own reason) in the same manner that we are. Certainly it is not relevant if we consider our pre-eminent concern to be the world as we know it, and thus such a time in such a far future is a priori not our theological problem. But then perhaps in some small way there will be enough of what makes humanity "us" that our theology will have some sliver of relevance to those of such a future. Similar to our many-worlds concern, there is a limit to the energy we can and should spend on such things. However, there is one way in which this future is definitely relevant, that of eschatology. Insomuch as our understanding of the end of the universe affects the end of humanity itself, so then this physical cosmology is of relevance to our theological cosmology.

Essentially there are three ways in which physics predicts the cosmos might end; heat death, perpetual expansion and dissolution, or collapse.[56] There was a time, only a couple of decades ago, when theory suggested that the collapse of the universe was the most likely. Many people interpreted this as being indicative of a cycle of rebirth for an infinitely existent cosmos. This was true for atheists that did not want to believe in a beginning or end of the cosmos; a

55 Regardless of the status of humanity, well before the theoretical end of the universe, our planet Earth will have likely been destroyed by the natural progression of our sun's thermonuclear lifespan (a mere 5 billion years from now). (Zeilik, 1992, pg. 307) Theoretically life of any sort will be unsustainable on Earth well before this.

56 All three of these predictions have been visualised and are explicated in the following, accessible to the layman, Youtube video: https://www.youtube.com/watch?v=4_aOIA-vyBo. (Kurzgesagt, 2014)

continuous cycle represented simply the states of a perpetual existence. (Penrose, 2004, pg.760) It was also true for theists that had trouble with the idea that God's creation might come to an end with nothing of note remaining. In both cases, it is hardly extraordinary to suggest that theologians might have some input regarding the existential angst either side was attempting to salve. Mind you, what is to be said of the other two options, both of which seem to be more likely given current observations of the universe's expansion? (Penrose, 2004, pg. 774) In the case of heat death, eventually the universe ceases to expand, but it is so spread out that ever so slowly it cools, without further physical interactions. By this point no stars are visible, no life as we know it is possible, even all chemical reactions cease. The other possibility is that the universe expands ever faster, the distance between things becoming so great that molecules are no longer bound together, in fact, even the forces that hold atomic particles together will be too weak and even atoms will break down. The universe becomes a vacuum, unimaginably thin, vacant of any semblance of the cosmos as we know it to be.

Heat death is perhaps the most disconcerting of these possibilities, the universe remains, just dead by all meaningful measure. It may persist indefinitely in this frozen state, or as random quantum mechanical events dictate it too may dissolve away.[57] Some speculate that the universe expanding indefinitely, and the resulting vacuum, is the perfect precursor to an entirely new Big Bang. This is not to say that it will be the same as the last, having a similar content in volume, mass, or energy. Just that there are similarities between what this theoretical evaporation of the universe looks like, and theories as to what may have given rise to our Big Bang. For our

57 If I am understanding the difference between the ever expansion of the universe and its inevitable heat death, the primary issue between the former and the latter is that with the expansion, time and space become meaningless in the same sense as before the Big Bang, as all things dissolve into and undifferentiated vacuum; with heat death, the universe could continue to persist indefinitely, with time and space continuing to have meaning in our sense even though there would be no one alive to make sense of it.

purposes, where might theology fit into this conversation about the end time of the universe? For starters, we can address the malaise that is inevitably part of the human condition when we face the expanse of the unfathomable, just as we always have. Science may be able to say what will happen, but this is not in itself informative about who we are or why we are significant. We can play with fantasy and science-fiction,[58] but such explorations, if taken seriously, are ultimately always in the language, and modes of reasoning, of theology. Good science admits that it has little or nothing to offer here, it adverts to the very concepts as being inane or meaningless to scientific understanding itself.

5 – An Elemental Conclusion

We began from the position that cosmology is the study of the nature of existence; with properly defined (and generally distinct) domains in science, philosophy, and theology. If physical cosmology (that of science) is concerned with the full collection of possible measurements for that which is existent, and philosophical cosmology is concerned not just with the nature of those measurements, but the reasoning surrounding and subsumed by them, then it is easy to judge the apparently subjective reliance of theological cosmologies. We therefore restricted ourselves primarily to speaking of theological cosmology as that which is properly relevant to the nature and meaning of "creation" within Roman Catholic thought. We also restricted ourselves to theoretical physical cosmology, rather than practical or applied science.

Our thesis relies on the authenticity of each of these three faculties when engaged in, and their respective defining of, cosmology; ultimately arguing that there is an inherent relationality

58 Merely as popular examples, Marvel Comics and the modern Doctor Who have both dealt with the time before and after the cosmos.

implicit in each. We did not attempt to resolve the epistemological divide between theology and science, instead arguing that from a commonality of cognitional process, theological cosmology and physical cosmology can engage in a mutually informative manner.

5.1 – A Modest Review

The structure of this thesis progressed from its introduction, through an historical review of selected interactions between the faculties and developments in their views on cosmologies. For this we specifically relied on works from the scholars Ernan McMillan, Hans Kung, and Roger Penrose. Afterwards, we explored the methodology of Bernard Lonergan, particularly his conception of interiority and cognitional processes. This itself was mediated by the works of James Pambrun, and his study of theological and philosophical hermeneutics. Finally we applied this methodology practically, with reference to works by William Stoeger, and again Roger Penrose.

Arguably, Galileo's work is the beginning of science's hallmark commitment to mathematics as a form of functional reasoning representative of the constitution of reality. But ultimately his work had deep roots both in ancient philosophy (knowingly or not) and contemporary theology (something he was definitely aware of). Of interest to our thesis is that the role of mathematics, or more precisely the "realness" of mathematics, is still a discussion being had in physical cosmology. Especially with respect to conflating the concepts of truth and realness, theology has plenty of relevant experience (as does philosophy).

Soon after, we introduced the work of Newton; and that the scientific revolution, through observation and mathematical modelling, has a self-consistency that leads naturally to authority.

Some, though not all, see this authority as a refutation of God's necessary existence (if not simply His imminence or power). With the increased abstraction of scientific insight, the sort Einstein provided, this became an intellectual trend that many militant atheists continue to promote.

Our second chapter was not written simply to inform the reader of some objective history of physical cosmology. Rather, it was intended to demonstrate the impact that developments in physical cosmology have had on our collective culture as well as both popular and academic theological cosmology. Even still, it nonetheless showed that the discipline of physical cosmology developed, in many cases, within a wider theistic culture or lens.

In exploring our methodology, we looked at the research of Pambrun into Lonergan. Noting that Pambrun advocated for applying Lonergan (synthesized with Paul Ricoeur) when addressing the tensions between science and theology, as early as 1993. Pambrun and Lonergan both highlight the importance which "validity and judgement" play in both faculties, and of the overall disposition towards "knowing being". Effectively making our initial point that this is not a minimisation of epistemological differences between theology and science, and that their ontological claims are not mutually dismissible simply on the basis of not meeting the other's criteria. Making it clear that theology is not science (nor vis-versa) precisely because their authorities are so intrinsically integrated with their methods, making them inherently distinct.

It is from here that we set three conditions for mediating science and theology. First, that the agents of the disciplines accept there is a basis for communication, and an acceptable existent venue. Second, that the agents mutually recognise that their discipline is not completely insular, by virtue of this basis and venue. And third, that the parties understand that philosophy as we

have so far explored it, provides the means for this while simultaneously protecting the independence of the faculties. Where we can meet these conditions is derived from Lonergan's acts of understanding: experience, understanding, and judgment. If properly applied, one should be able to answer: “What am I doing when I am knowing?”; “Why is doing that knowing?”; and “What do I know when I do it?”. Further, if both the theologian and the scientist have authentically engaged with these questions they will in fact be tacitly engaged in communication (if not directly with one another at least with one another's subject).

With the help of Pambrun we explored what it means for a theologian to be authentic, creating a theoretical means by which to explore the authenticity of an agent of either faculty through an analysis of their interiority. In our penultimate chapter we further explored this interiority – in no way inferring that a theologian is an authority to the physicist's interiority (nor vis-versa) – and thus they are not the judge of the other's authenticity. This was our proposed model, by which one might bring themself as theologian to an intellectual moment which is recognisable by a physicist engaging in a similarly reflective activity.

With the theoretical nature of the previous in mind, we proceeded to build a proof of concept. Continuing our role as theologian, but also by playing the role of a hypothetical physicist (keeping in mind the previous admonition), we reconstructed an actual physicist's disposition from their personal works. In this case, it is the interiority of Roger Penrose which become our simulacrum. This was done with the full understanding that we are merely role-playing to demonstrate the concept. It is our sincere hope is that our exercise engender an actual physicist to replace our role-play with the genuine exploration of their interiority. Such an exploration would allow for our method to be tried in actuality.

We progressed by explaining the mode of reasoning for the physical cosmologist. The imaginative use of mathematics in a rigorous, yet creative, effort to model phenomenological observations in a manner which can be effectively and numerically analysed, and whose predictions can be tested in a similarly observational manner. Nothing like the mode of reasoning for theology, but if accepted (even with revision) it is proof that their mode of reasoning it intelligible to a theological mindset.

In describing our mode of reasoning; that theology is faith seeking understanding, the question arises, "is this something a physicist can accept as reasonable and rational"? Thus it behoves us to make this understandable to a scientist. We proposed that only by engaging with scientists as people, and not specifically as professional identities, will we demonstrate what it is that theologians do in society generally as well as in academia. If we demonstrate that our discipline has rational, effective, results in the world, then scientists as people will be more apt to accept our mode of reasoning (both in principle and in regards to our discipline alone).

At this point we turned to the unmediated works of Lonergan in an effort to discover his acts of understanding within the methods of scientists. The essential operations of scientific inquiry cannot simply one-for-one be substituted for his cognitional structure since they do not share equivalency. As Lonergan's model is cyclical, involving layers of repeated reflection, then when we choose any convenient starting point, it is not a surprise that elements of our model are evident in each of the stages of the scientific operations.

In as much as we have been successful, a scientist ought to be able to recognise, in our description, there own self. Thereby we met all three of the earlier set out conditions. We have a means with which to engage in dialogue! From herein, our thesis attempted to generate a

theological discussion around modern physical cosmology. We re-explored some of the topics we covered in chapter 2 – Cosmology in History, but also more theoretical conversations that tend to be being had, and which often provide fodder for atheists or at least consternation for sceptics, but which even physical cosmologists struggle with collectively. The point is not a classic apology, nor to head-off criticism, nor to prove theology superior. The point, in all humility, is to use our newly developed method to express ourselves in such a way that a physical cosmologist may be able to appropriate our position on these topics, and therefore, perhaps prove ourselves of some competence if not value.

5.2 – A New Hope

It is important to remember that when we said theology may have a positive, constructive, impact on science, this was not an assertion that better science is science accounting for or to theology. It is merely an assertion that as a theologian one can take advantage of science without being a scientist, while nonetheless admitting to scientific curiosity; by corollary a scientist can take advantage of theology not by being a person of a specific faith, but admitting the good practices of theological interest as it pertains to their own beliefs (i.e. critical analysis of their dispositions, desires, intents, even as unconscious or abstracted as they may be). Ultimately this has been an attempt to explore the functionality of a theology of cosmology and not a defence or exploration of theological cosmology; nor its "primacy" over physical or philosophical cosmologies.

We have explored, through Lonergan, how all seeking of knowledge and experience is an act of authenticity. Even an act of science occurs within these parameters; regardless of an

idealised agnostic/atheist culture, there must be a creative effort and an apprehension of being. Inasmuch as we have demonstrated this experience through history (recent and Renaissance), we can say that theology must not be relegated merely to the contribution of practical ethics in regards to science, and thus its relevance subject to atheist critique. Instead theology is uniquely placed to discuss and explore the "culture" of science itself, or at least the implicit culture of any given scientific moment as it pertains to cosmology. It is this exploration which can fruitfully add to science not as observation or deductive knowledge but as some necessary if small measure of creative authenticity.

With everything we have explored, is it too much to suggest that theology aught to mediate science to the faithful, again not as a science, but with respect to science as a source of revelation? And if so, does this mediation then influence (for better or worse) the future science practised by the faithful? After all, if theology challenges our human identity by attempting to engage with the transcendent then is it not proper for it to be supplanted by other technical disciplines as their fields of expertise rise to new horizons, as asserted by Lonergan. If so, it must also be proper to say that theology adds to those disciplines by raising their awareness to new horizons of human concern.[59] In this sense it can also be suggested that theology must be present both at the beginning and the the end of scientific exploration (i.e. the hypothesis and conclusion portions of hypothesis, apparatus, observation, analysis, and conclusion). Not as a part of the method's structure, but implicitly first to inspire a motive and then to explicate an impact. This is more than the assertion just previous, in that it is not merely a matter of ethics. Theology is not required to justify nor rationalise a scientific endeavour. More precisely in this

59 It could be contended that this last assertion is precisely the premise explored by Scott Derek Garcia Ventureyra in his research paper "Theology's Fruitful Contribution to the Natural Sciences: Robert Russell's 'Creative Mutual Interaction' in Operation With Eschatology, Resurrection and Cosmology", 2009. Though I feel we have suggested a much broader scope than is his focus.

case we are suggesting that theology can better grasp the existential, human, motivation behind the science as well as the full breadth of what transcendent impact that science has on the human condition.

As we have repeated, it is a sincere hope not that our hypothesis has been conclusively proven, but that the reader is left with a sense that our hypothesis is defensible. That it is proven in concept, such that it might meaningfully engage the mind of a scientist whom is so inclined. In doing so, it is our contention that the scientist can constructively add to our understanding not with the intention to repudiate theology and its role in cosmology, but to normalise the discourse while correcting any oversights or misconceptions regarding physical cosmology which have found their way into our appropriations. If this paper were to choose one final thought from Lonergan with which to leave you, it would be: "Knowing is affirming what one correctly understands in one's own experience. Belief is accepting what we are told by others on whom we reasonably rely." (Doran, Insight, 2005, pg. 452)

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