Science and Theology:

An Integrative Approach

A Thesis

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ABSTRACT

Science and Theology are two complementary disciplines. By "theology," I am usually referring to philosophical theology in the context of this thesis. Theology provides the metaphysical framework for science. Science lays the ontological foundation for natural theology. The heart of theology is the doctrine of the Trinity. Nature is a representation of the triune Godhead. To reflect reality accurately, scientific theories must be modeled after the Trinity. Eternity and the Trinity are complementary concepts. Eternity is the synthesis of time and timelessness in which triunity is a necessary condition to resolve its theoretical difficulties. In agreement with Christian orthodoxy, the Trinity essentially refers to three divine Persons as one God. The concept of the Trinity can be used as a metaphysical basis for the construction of an *avant-garde* version of the Grand Unification Theory.

PREFACE

I took on the impossible task of writing a Th.M. thesis on the Trinity about three years ago. The beginning of this arduous activity was beset with many false starts and impasses which eventually led me to abandon the project. Subsequently I resorted to a less controversial topic in the area of science and theology. During the course of researching my second topic, the Trinity assumed a life of its own and found its way back into my thinking. What seemed to be the burden of a mere academic exercise at first has turned into a joy of discovery at the end. In this small work, I have chanced upon the answers to many difficult questions which have perplexed me for many years. More surprisingly, a spiritual transformation took place through an otherwise purely intellectual exercise. I suspect that it is due to the constant exposure to the writings of many great minds who are committed to truth seeking and a deep passion for knowing God. As a result, I have connected with these intellectual giants vicariously and, surprisingly, have developed a greater appreciation for tradition.

In this thesis, I try to achieve as much clarity and breadth as possible. Obviously, it is impossible to espouse a comprehensive exposé on all

relevant topics on science and theology within the scope of a short work. Many non-trivial presuppositions, such as the existence of God, the authenticity of the Bible and the validity of the Christian orthodoxy, are simply taken as the starting points of this thesis. Each of these presuppositions is a thesis all by itself and cannot be individually examined with the rigor it deserves. Despite the limitation of scope, I nevertheless wish to briefly justify some of my presuppositions for the sake of completeness.

The first presupposition of this thesis is the existence of God. There is a long tradition of arguments for the existence of God—the cosmological argument, the teleological argument, the moral argument and the ontological argument.[1] Examples of good works which argue for the existence of God are J. P. Moreland's books Does God Exist? and Scaling the Secular City.[2] In my own mind, the existence of God is a logical necessity as well as an experiential knowledge. As an evidence for the existence of God, I will sketch a logical argument as follow: Anselm defines God as "a being than which nothing greater can be conceived." In other words, God is a maximally perfect being. If God does not exist, no maximally perfect being

[1]Walter A. Elwell, Evangelical Dictionary of Theology (Grand Rapids: Baker, 1984), 447-451.

[2]J. P. Moreland, Does God Exist? (Nashville: Thomas Nelson, 1990), and Scaling the Secular City (Grand Rapids: Baker, 1987).

exists. However there is always a most perfect being. This most perfect being lacks the qualities which qualifies him for maximal perfection—qualities which can be conceived but not attained. Unattainable qualities have no relevance because they do not and cannot relate to reality. Such qualities are tautological and expendable. If the most perfect being opts to unlearn such tautological concepts, he will have removed the hindrance toward maximal perfection. This way, relative perfection is promoted to maximal perfection which in turn translates to divinity. At the end, the relatively most perfect being becomes God. This reasoning reaches the conclusion that the non-existence of God leads to the existence of God, which is a contradiction in terms. Therefore, "God does not exist" is shown to be false *reductio ad absurdum*. Given that God exists, God must also be unique. There cannot be a multiplicity of maximal perfection. All perfect traits can be amalgamated into a whole. Maximally perfect beings must share a co-equal and co-essential nature of one οὐσία. This condition reminiscences the μία οὐσία ὑπόστασεις nature of the Trinity which will be elucidated in chapter 4. Moses declares that God is one יְהוָה אֶחָד

(Deut. 6:4). The word אֶחָד "speaks not only of the *uniqueness*, but also the *unity* of God."[3] The uniqueness of God is important in the integration of science and theology. Uniqueness in theoretical science is an important quality from a mathematical perspective (unique solutions to differential equations, etc.) and from a philosophical point of view (unity of nature). The observed uniformity of Nature suggests a unity of intelligence behind the creation.

The second presupposition of this thesis is the authenticity of the Bible. Different religions base their beliefs on different sacred scriptures which depict different gods of different natures. Given the uniqueness of God, the God of the Bible cannot also be the god of Voodoo, Buddhism, Hinduism, Islam and Judaism since these gods do not converge on a unity of essence. Although the Bible never explicitly rejects the sacred writings of other religions, the God of the Bible does solemnly condemn the worship of other gods. Sacred writings which do not point to the God of the Bible are false prophecies. The Hebrew קָדוֹשׁ and Greek ἅγιος for "holy" both mean "separated or set apart." The Bible is holy in the sense that it is unique—*set apart* from the sacred writings of other world religions. Indeed one of the

[3]Duane L. Christensen, Word Biblical Commentary: Deuteronomy 1-11, vol. 6A (Dallas: Word Books, 1991), 145. Peter C. Craigie, The New International Commentary of the Old Testament: The Book of Deuteronomy (Grand Rapids: Eerdmans, 1976), 169.

most common challenges against Christian theism is directed toward the authenticity and the uniqueness of the Bible. The content of the Bible has stood the test of time in terms of archaeology, history and textual criticism. The complex issues of Bibliology cannot be treated here. Those who are interested in these topics are advised to look elsewhere. A good general level text is Josh McDowell's A Ready Defense.[4] Werner Keller's The Bible as History is also an excellent source on Biblical archaeology.[5] The question of authenticity in literature is not an easy one to answer. Suppose that William Shakespeare really existed and that he personally wrote Romeo and Juliet. How can I logically prove that William Shakespeare is indeed the true author of this play? I do not know how. Perhaps the best I can do is to show from circumstantial evidence that he is the authentic author beyond reasonable doubts. The proof of authenticity is primarily a problem of literary criticism. In the case of the Bible, I cannot think of a short pithy answer to justify my claim that the Bible is inspired by God. The appeal to the Scripture (*e.g.* 2 Timothy 3:16) for proofs of the divine inspiration is circular reasoning at best. In order to avoid the burden of literary criticism, I

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[4]Josh McDowell, A Ready Defense (San Bernardino, CA: Here's Life, 1990).

[5]Werner Keller, The Bible as History (New York: Morrow, 1981).

will simply state without proof that my presupposition of biblical inerrancy is carefully considered and intellectually justified.

Given that God exists and that the Bible is the unique revelation of God, we are still burdened with the task of discerning a correct interpretation thereof from a conglomerate of theological positions. In writing this thesis, I have tried to follow the precepts of Christian orthodoxy as closely as possible. Relevant presuppositions assumed under the auspice of Christian orthodoxy are Biblical inerrancy, the doctrine of the Trinity and natural theology. Nowadays any prejudice toward a narrow tradition is automatically a suspect in our politically-correct society. Truth seeking is an extremely narrow enterprise. The long tradition of Christian orthodoxy has been honed by generations of adamant debates and relentless scrutiny. Although orthodoxy may not have attained a final form yet, many treasures of the mind are indubitably buried in centuries of cumulative knowledge. We are able to see farther on the shoulders of giants as we plant ourselves on a long tradition of thoughts. On the other hand, we must be careful not to close our minds to new discoveries in theology. A typical Renaissance motto is that all that is really worth knowing has long been known. Robert Oppenheimer objects to this brash fatalistic assumption from the counter-

examples of the rapid development in modern science.[6] Unlike science, theology will surely grow in a much slower pace due to the maturity of its cumulative wisdom. Although theology may still have room for further expansion, it is highly speculative that the basic tenets of orthodoxy will be drastically revised in light of new evidence. Until such a time comes when the theological world is in need of another Reformation, orthodoxy is still the most reasonable choice of a theological position as the metaphysical and epistemological foundation for integrating science and theology.

This thesis is intended to be a rigorous study on the integration of science and theology. In writing this thesis, I have tried to be conscientious in keeping the style of writing assessable to most seminarians. Efforts are made to eliminate the use of formulas from the main text. When formulas are necessary for technical clarifications and the derivations of mathematical principles, I restrict them to the footnotes and the appendixes. Chapters 1-4 focus on theology, philosophy and history. Chapter 5 is devoted to deriving a Grand Unification Theory as an example of how theology can actually impact theoretical science.

Finally, I like to acknowledge all my colleagues who have contributed to the writing of this thesis. My special gratitude is directed to Dr. Robert

[6]J. Robert Oppenheimer, Science and the Common Understanding (New York: Simon and Schuster,

Saucy who has patiently and meticulously pointed out the weaknesses of my theological ideas along every step of the way. I also like to acknowledge the insightful remarks made by Dr. John Bloom of the Physics Department and Dr. Peter Woo of the Mathematics Department here at Biola University. Both Prof. Ernest Abers and Dr. Ralph Wuerker of the Physics Department of UCLA has sacrificially taken much of their valuable time from research to critique my massen field theory.

1954), 15.

LIST OF MATHEMATICAL NOTATIONS

List of Mathematical Symbols

≡	identical to (is defined as)
ú	set of real numbers
÷	set of complex numbers
{ … }	a set of …
∈	an element of
⊂	a subset of
∪	union
∩	intersection
∅	empty set
→	is mapped to
~	logical negation
∧	logical and
∨	logical or
$\hat{H}$	quantum mechanical operator

$\hbar$	Planck constant 1.06×10^{-34} J s
c	speed of light 3×10^{8} m s^{-1}
k	Boltzmann constant 1.38×10^{-23} J K^{-1}
$\mathbf{V}$	vector
V^{μ}	component of a vector
$T^{\mu_1 \cdots \mu_k}{}_{\nu_1 \cdots \nu_l}$	component of a tensor

CHAPTER 1

INTRODUCTION

The search for a worldview is a uniquely human activity. We are radically dissimilar from animals in that we transcend our basic desires for survival to entertain the prospect of understanding the world in which we live. Science has played an important role in forming our world views. In modern times, science has threatened to replace theology in the Western culture. Christians must become more actively engaged in thinking theologio-scientifically if Christianity is to be saved from an ideological extinction.

The Problem of the Study

After a long history of exchange, science and theology have not yet risen to a level of mutual appreciation. While some Christian thinkers have taken great strikes to bridge the gulf separating the two disciplines, others remain skeptical. Physicist Howard Van Till protests against the intrusion of

theology on science.[7] J. P. Moreland on the other hand positively asserts that science and theology are not demarcated.[8] It is obvious that there is not a unanimous consensus among the evangelicals on the subject of integration.

The purpose of this thesis is to examine the nature of science and theology and to show that the prospect of integration is promising. Currently there are many problems in theology and science which have defied our efforts to solve them. The main part of the study concerns the elucidation of a small set of these problems and the practical implementation of solutions therefrom. The highlight of this thesis is to show that the doctrine of the Trinity is an essential ground for physical theories. According to Karl Barth, the Trinity is the ultimate mystery of the universe even after two thousand years of adamant theological debates. Flaunting a flagrant insubordination to a blind acceptance of tradition and authority, I will make an iconoclastic attempt to challenge the finality of Barth's *trinitatis mysterium* in chapter 4 and subsequently adopt the concept of the Trinity as a basis for constructing an *avant-garde* Grand Unification Theory in chapter 5.

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[7]Howard J. Van Till, Portraits of Creation (Grand Rapids: Eerdmans, 1990), 149.

[8]J. P. Moreland, Christianity and the Nature of Science (Grand Rapids: Baker, 1989), 99.

The Importance of the Study

A worldview is simply a way by which we interpret the world. As Christians, we view the world as God's creation (Gen. 1:1-4, 11-6; 2:2, 4, 7, 18-25; Rom. 8:19, 22; 2 Cor. 4:6; Heb. 4:3). An evangelical theology based on a careful exegesis of the Holy Scripture provides a sufficiently self-consistent and practical worldview for the daily functioning of a Christian. Some are concerned that a theologio-scientific integration is an academic can of worms which promises nothing more than wasteful controversies. In the safety of evangelicalism, many Christians become increasingly ignorant of the philosophical thinking of the modern world. If the church continues to shy away from contemporary issues, it will eventually become an example of cultural irrelevance. On the university campuses where the forefront of intellectual progress takes place, the secularist challenges are often dressed in scientific mantles. There is a need to form a habit of critical thinking in connection with science and theology. A discourse between science and theology is an invaluable forum in which many surprising insights can be generated. Inter-disciplinary studies which seeks to integrate the partial solutions of various problems such the Trinity, the nature of spacetime, Grand Unification Theory and cosmogony may chance upon unexpected

turns on the road to discovery. In light of the challenge of anti-intellectualism and postmodernist skepticism, Christian thinkers have everything to gain by taking bold steps out of the comfort zone.

By actively engaging with science, theologians can dispel the false accusation that Christianity is a cultural relic which is destined to degenerate to the status of a cult. In order to preserve the prominence of Christianity in the society, we need to effectively interact with the dominant culture and its science. It is my opinion that, by allying science and theology, we will enrich our understanding of both God and the world.

The Limitation of the Study

The vastness of the subject of integration looms over voluminous writings spanning many centuries. Although key works are concentrated mostly in the period beginning in the 19th century, an exhaustive historical survey is beyond the scope of this thesis. Consequently I have resorted to making historical references only as much as necessary. It is not the purpose of this work to give a comprehensive review on everything that has been done on science and theology. The multiplicity of modern science itself is a monster that will outlive the lifetime of any single assiduous researcher. Therefore the focus of this *opus culum* is intentionally designed to be narrow

in terms of answering the questions of integrating physics and theology. My choice of physics out of all sciences is twofold: (1) The domain of physics, philosophy and theology are coincidentally the most basic elements of reality. These disciplines are closely akin in their intellectual habits. Hence their integration is most natural. (2) Physics, philosophy and theology are my areas of exposure. I for one like to mitigate the conflicts among different systems of knowledge and for two hope to make big strikes in seeing the world from a more holistic vantage point.

The Methodology of the Study

Integration has become a fashionable ambition in recent years on many evangelical campuses. Despite the juvenility of the resurgence, many high quality works have already begun to circulate among the academia. Chapter 2 surveys some of the recent works as well as the traditional *opera magna*. It will be self-evident that recent scholarship on integration succeeds in clarifying thinking but fails to offer a practical road map leading toward the enlightenment. To ameliorate the present impasse, chapters 3-5 makes an chivalrous attempt on the impossible task of clearing the forest of ideas to find the path toward enlightenment. Throughout the core of the this

program, the concept of the Trinity is the map that guides the pilgrims through the dense foliage.

CHAPTER 2

HISTORY OF RESEARCH

Historical studies often surprise us with the joy of many unexpected discoveries of gems of insights. It is expedient to learn from the past so that time is not wasted in reinventing the wheel. Before we delve into the main part of the thesis, it is wise to survey the development made along the line of integrating science and theology.

Science versus Theology

The history of science versus theology is marred by many unhappy memories. Astronomers today often use the persecutions of Galileo and Copernicus as horrible examples of the church as an evil malefactor of scientific progress. Incidentally the majority of the faculty on any secular campus are of the atheistic persuasion. To the secularists, the belief in God is a medieval superstition held together by a Freudian type infantile sexual fantasy. On the other side of the fence, science is also a suspect in the minds of many Christians because of its atheistic demeanor. The estrangement

between science and theology has been ameliorated in recent times as many able apologists have broken the ice through dialogues with secularists. Since Christians are inconspicuously imputed with the guilt of benightedness in a secular society, the burden of proof is on us. In summary, a postmortem on the regress of Christianity from modern culture and some of the its attempts to amend the alienation is of great import.

Science as a Token of Renaissance

Francis Schaeffer, when analyzing the cultural shift of the 19th century Europe, realized that the development in philosophy is a catalyst of cultural transformation.[9] Unlike the rise of the 19th century thought which was immortalized by the existential philosophy of Søren Kierkegaard, the emergence of the Renaissance period, first ushered in as a revolution of art in the 15th century, was not sparked by any well defined philosophical genre. The Renaissance simply represents a spontaneous shift from medieval theology toward humanism, which signals a return to the paganism of the classical Greek period. The paganistic fascination is exemplified by works such as Sandro Boticelli's Birth of Venus after 1482. The humanistic vein runs through the Renaissance corpus and is captured by the maxim

[9]Francis Schaeffer, The God Who is There (Downers Grove, IL: IVP, 1968), 15-16.

"Man can do what he will."[10] Thomas Aquinas, the greatest medieval theologian and artisan of synthesis, emboldened the Aristotelian *a priori* reasoning as a ground for knowledge.[11] Francis Bacon, hailed as the father of Renaissance, rejected the Aristotelian logic since his days as a student in Trinity College. Bacon is exalted to the status of a mythological figure because he broke the tie with the mainstream medieval logic to "go to the heart of the matter in his advocacy of observation and experiment instead of deduction from *a priori* principles."[12] The rejection of *a priori* reason revolutionized the nature of intellectual discourses: "Here and there, in universities and monasteries and hidden retreats, men ceased to dispute and began to search."[13] Science since then has earned a reputation as the impious rebel against ecclesiastical authority. Kepler, Galileo and Copernicus were the token rebels of their days. The multiplicity of persecutions and synods failed to retard the progress of the Renaissance spirit. On the contrary, hardships served only to spur the revolutionists to

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[10]Michael Wood, Bruce Cole, and Adelheid Gealt, Art of the Western World (New York: Summit, 1989), 108.

[11]N. L. Geisler, "Thomas Aquinas," Evangelical Dictionary of Theology, edited by Walter A. Elwell (Grand Rapids: Baker, 1984), 1091.

[12]J. M. Roberts, History of the World (New York: Oxford, 1992), 541.

[13]Will Durant, The Story of Philosophy (New York: Simon and Schuster, 1961), 82.

champion against intellectual oppression. It was ominous that scientific thinking would eventually replace theology in the Western cultural milieu. At last, the demise of the medieval worldview was officiated by the publication of Immanuel Kant's Critique of Pure Reason (*Kritik der reinen Vernunft*) in 1781.

The struggle between scientists and clergymen manifested itself in the form of an irreconcilable dichotomy between tradition and freedom. Free thinking, as a negative reaction against the *a priori* approach in church dogmatics, bred a conglomerate of secular philosophies. The wild fire of secularization spread uncontrollably throughout the post-Christian world. Darwin's Origin of Species offers a mechanism for the emergence of life without a Creator. Freud's psychoanalysis supplants the credibility of all religious feelings by antiquating them as forms of infantile sexual feelings. Einstein's relativity theory is often misconstrued to be an argument for relativism. On the contrary, there is not another scientist more religious and absolutist than Einstein in modern time.[14] Niels Bohr, one of the inventors of quantum mechanics, is the father of the Copenhagen positivism. His anti-realism has worked its way into his interpretation of quantum physics. He wrote,

[14]Charles Henderson, God and Science (Atlanta: John Knox, 1986), 14.

> There is no quantum world. There is only an abstract physical description. It is wrong to think that the task of physics is to find out how nature is. Physics concerns what we can say about nature.[15]

Positivism gives way to physicalism in science. Bas Van Fraassen's empiricist view is a *lingua franca* in the 20th century scientific world. The criterion of "empirical adequacy" is nominally accepted by many as the standard of knowledge.[16] Physicalism seeks to purge all reference to things spooky and unphysical from the scientific vocabulary. Its utopia is a universe which consists solely of matter and energy, certainly nothing of any transcendental nature. When the resurgence of religious talk found its way back to popular science in the 70's and 80's, pantheism became an acceptable expression of science and religion. Physicists Fritjof Capra and Gary Zukav succeeded in integrating eastern mysticism with modern physics on a popular level. Capra's bestseller The Tao of Physics and Zukav's Dancing Wu Li Masters are nevertheless poor examples of religio-scientific scholarship in terms of the authors' naiveté of the Western theological tradition.[17] Even though the central tenet of interpreting quantum theory through the pantheist spectacle is theoretically dubious, the popularity of

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[15]Jim Baggott, The Meaning of Quantum Theory (Oxford: Oxford, 1992), 84.

[16]Bas C. Van Fraassen, Quantum Mechanics: An Empiricist View (Oxford: Clarendon, 1991), 3-4.

[17]Henderson, 134.

Capra's and Zukav's works is still indicative of the basic human need for a higher meaning which a mechanistic worldview does not permit.

The 20th century culture is marked by another shift from scientism to postmodernism as a generation of renegades have grown increasingly disillusioned by science and technology in the midst of uncertainties and unemployment. Journalist John Hogan, in The End of Science, paints a morbid picture for the future of science. His postmodernist pessimism is in unison with the general sentiment among the scientific gurus that pure science may have reached its limit. Physicist Louis Osborne at MIT once told me that physics is an experimental science. Experimental breakthroughs in a way depends on the advance of technology. Technological development is in turn influenced by economics and politics. In practice, physics as a minute element of modern culture is not the master of its own destiny. Beside the considerations of economics and politics, there is also a physical limit to what technology can do. In order to understand the severity of the technological limit of experimental sciences, it suffices to know that the construction of a 1000 light year long particle accelerator is needed to test the superstring and the Big Bang theory. For this reason, physicists believe that particle physics and cosmology will

eventually cease to be science and will slowly denigrate to a branch of philosophy. [18]

The end of verificationism seriously undermines the doctrine of scientific empiricism. The post-cold-war physics is hampered by budget crises and the rise of the postmodernist anti-rationalism. Many prophets of doom foretell the end of science. Although science as an enterprise may have to make certain adjustments in order to meet its economical demands, science as a critical expression of our own curiosity will continue to find its niche in the society as long as good questions are there to tickle our imagination. Thinkers live to think. Good questions are not forsaken even in times of poverty and unpopularity. Kant was insightful about the inquisitive and theoretical nature of human reason,

> For human reason, without any instigations imputable to the mere vanity of great knowledge, unceasingly progresses, urged on by its own feeling of need, towards such questions as cannot be answered by any empirical application of reason, or principles derived therefrom; and so there has ever existed in every man some system of metaphysics.[19]

There are always a few good scientists who think, not for the sake of necessity, but for the sake of pleasure. Although non-believing scientists are apt to err in their judgments by trying to make sense of the creation without

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[18]John Hogan, The End of Science (Reading, MA: Addison-Wesley, 1996), 90-91.

[19]Immanuel Kant, Critique of Pure Reason, translated by J. M. D. Meilklejohn (New York: Willey, 1943), 13.

the Creator, their relentless scientific inquiry will occasionally chance upon elements of truth that will help to shed light on the nature of the universe when they are reconnected to theology.

Theology in Turmoil

Theologians, as citizens of their own cultures, are not invulnerable under the currents of contemporary thoughts. Francis Schaeffer draws "a line of despair" consisting of the five steps of descent alongside the cultural development of the 19th century Europe and America. This line of despair begins with Kierkegaard's existentialism and ends with Karl Barth's neo-orthodoxy.[20] Schaeffer distinguishes Kant as a classical philosopher who ascribes to thesis and antithesis as the source of knowledge. A thesis is an idea and the antithesis its opposite. Kant basically holds to a basic classical notion of the non-contradiction. Then came Hegel who literally changed the nature of thought in the Western world by replacing thesis and antithesis with synthesis in dialectics. Hegel's first business was to dissect Kant's categories of being, quality, quantity, relation and so on. The most pervasive of them all is relation. To Hegel, every idea is a group of

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[20]Schaeffer, 15-16.

relations. An idea without a relation is empty; it is what he means when he said, "Pure Being and Nothing are the same." Of all relations, the most universal is that of contrast or opposition. Every idea leads to its opposite or every thesis its antithesis. Hegel's innovation is to unite theses and antitheses to form a higher and more complex whole. Synthesis refers to the view of truth as an organic unity of opposite parts.[21] Thesis, antithesis and synthesis constitute the formula of all development and all reality. Thus Hegel opens the door to evolution and process theology. However, Hegel is still an idealist in that he believed reason is the way to knowledge. Kierkegaard on the other hand undermines rationalism by superseding reason with "the leap of faith." The result is an existentialist approach to knowledge based on personal experience. The leap of faith is neither a blind faith nor the fideist madness; it is the core of Kierkegaard's bipolar relational logic by which the ordered sequence is broken to allow for freedom of the will.[22] Kierkegaard opposed Hegel's trichotomous logic of thesis, antithesis and synthesis and offered the dichotomous relational logic of spirit as the alternative. Many years later, theology, led by existential philosophy, followed the line of despair to Barth's neo-orthodoxy. Barth

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[21]Will Durant, The Story of Philosophy (New York: Simon and Schuster, 1961), 223.

[22]James E. Loder and W. Jim Neidhardt, The Knight's Move (Colorado Springs: Helmers & Howard, 1992), 129-130.

began his career as a liberal theologian imbibed in literature on higher criticism, but later grew dissatisfied with the emptiness of an analytical religion. He wanted to find meaning in religion again by rediscovering the simplicity of faith. Many commentators hail Barth as the last of the great theologians in the 19th century who defends Christianity against liberalism. Schaeffer on the other hand criticized Barth as an existentialist with a liberal view of scripture.[23]

Schaeffer favors the biblical conservatism of the Reformation. The Reformers sought to free the minds of the believing populace from the monopoly of Scriptural interpretation and the theological feudalism of Catholicism. Luther turned the Protestants from papal traditions to the Scripture in the manner of *sola scriptura*. He translated the Bible in German so that every thinking Christian could read and interpret the Scripture for himself. The Reformism was in a way indebted to the humanist rationalism of the Renaissance. Rationalism provided a free rein for the freedom of theological expression. After the reformation period, there was no clear unanimous consent of the role of reason in religious epistemology. Pascal for example believes that reason cannot lead to a knowledge of the existence

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[23]Schaeffer, 51-54.

of God. But it was not until the 19th century that the skepticism against the rational structure of knowledge found a formal expression in Kierkegaard's existentialism which was finally encapsulated in neo-orthodoxy.

Schaeffer refers to neo-orthodox theology as "anti-theology"[24] because the experience which constitutes the "leap of faith" is neither explicable nor communicable and renders no objective meaning. Furthermore existentialism defies verification. Schaeffer says,

> As far as the theologians are concerned, they have separated religious truth from contact with science on the one hand and history on the other. Their new system is not open to verification, it must simply be believed.[25]

The existentialism in the 19th century paved the way to mysticism in the 20th century. The pendulum of thought then swung from rationalism to anti-rationalism, and from science to anti-science, even among the experts. The muddling heresy of physics and eastern mysticism was seeded during the formative period of quantum mechanics. Erwin Schröedinger, the Nobelist who invented the wave equation in quantum mechanics, was a radical pantheist. On mystic vision, he once said,

> " … the plurality that we perceive is only *an appearance*; it is not *real.* Vedantic philosophy, in which this is a fundamental dogma, has clarified it by a number of analogies, … Thus you throw yourself flat

[24]Ibid., 53.

[25]Ibid., 54.

> on the ground, stretch out upon mother earth, with the certain conviction that you are one with her and she with you."[26]

Schröedinger was not alone in espousing mystical belief, there were other prominent physicists who also subscribed to mysticism, such as De Broglie and Sir Eddington. Pantheism continues to influence the interpretation of science even today. Unfortunately there has not been a significant presence of Christian thinkers in science to leave a theological imprint for posterity.

It is possible that, if theologians would have actively engaged in science sooner, the present situation would be less bleak. Schaeffer claims that theology has historically been a follower rather than a leader in cultural development. Theologians adopt the philosophy of the previous decades and transmute it as something new. In the 19th century, the sea of new ideas was tossing in the titanic waves of liberalism and existentialism. Those who were caught in the torrents of modernization were either lost in a search for the historical Jesus or perished from leaping into the abyss of anti-theology. The faithful retreated to safety on isolated highlands of the old orthodoxy. They built fortresses to protect themselves from future catastrophes, from which many of our evangelical seminaries and schools were spawned. There are some belated remedial effects among a small number of evangelical

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[26]Ken Wilber, Quantum Questions (Boston: Shambhala: 1984), 95-97.

scholars to re-engage in science. Unfortunately, after decades of erosion, the currents of anti-theology have effectively destroyed the historic strongholds once held by orthodox theology.

Following the defamation of Christianity, the postmodern villains hurl brazen attacks on the core of order and meaning. Prevailed by a feeling of melancholic delusion, the present intellectual climate is not only characterized as being anti-Christian, but also anti-rationalist and anti-science as well. In politics, feminists attack the "gendered language" in science . Public interest in paranormal and superstition has increased even among the well-educated and higher-income population.[27] In the crossfire between postmodernism and rationalism, creation research has fallen victim to the unjust accusation of anti-science. Unfortunately this kind of negative publicity misrepresents to the public a spectrum of Christian scholarship which is much broader than young earth creationism. The integration of science and theology must go beyond exploiting media frenzy to answering the deeper questions of metaphysics and epistemology. There was a long period of decadence in the history of the church in which anti-intellectualism branded philosophy and science as diabolic. The offspring of such

[27]Gary Stix, Sasha Nemecek, and Philip Yam, "Science versus Antiscience?" Scientific American, (January 1997), 96-101.

superstition is an imbecilic giant who is becoming increasingly insipid from a dysfunctional doctrinaire self-absorption. Fortunately, God has a way of rescuing Christian scholarship from the hands of ignoramuses. The barren soil can be turned into a luscious garden if more attention is directed toward grafting science and theology.

Some Examples of Integrating Science and Theology

There exists the rudiment of a theological foundation for integrating science and theology. I will briefly survey some of the main ideas being circulated in the evangelical circle as a way to assess our present situation.

Creation Science as a Catastrophic Theory

The aim of creation research is to interpret science in ways which support a six-day creationism. Creation research is spearheaded by Henry Morris and John Whitcomb and their Institute of Creation Research. Critics argue that, beside Robert Gentry's work on radioactive halos[28], none of the creation researchers are known to have conducted experiments. Their criticism is moot. Singular events, such as history, are not subject to the

[28]Robert V. Gentry, "Extinct Radioactivity and the Discovery of a New Pleochroic Halo," Nature, vol. 213 (February 4, 1967), 487-489, and "Fossil Alpha-Recoil Analysis of Certain Variant Radioactive Halos," Science, vol. 160 (June 14, 1968), 1228-30.

same verification criteria of laboratory science. Creation, as a singular historical event which we call a miracle, is more suitably judged by historical methods than empirical repeatability. On historical methods, Stanley Jaki wrote,

> Its [historical event's] verification, even in the case of a fresh miracle, is essentially one involving the historical method with its reliance on direct witness, on indirect observation, and circumstantial evidence.[29]

Creation research's program is more along the line of rhetoric and history than science. For this reason, I do not refer to them as creation scientists, just creation researchers. Henry Morris and his adherents served the purpose of defending biblical inerrancy in a time when Christian orthodoxy was most vulnerable. Unfortunately, the creationists have earned themselves a reputation as antagonists. Instead of engaging with modern culture, they perpetuate the myth that Christians are outsiders to the scientific enterprise. In a recent report in Scientific American, creationism, along with feminism and superstition, is made an example of antiscience. The alienation between modern culture and creationism is acutely felt through the writer's sarcasm,

> In this environment, Morris's tiny museum near the cowboy bar and the drive-in movie theater may serve as a model for an entire movement that chooses to guard its precious isolation on the outskirts of town.[30]

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[29]Stanley Jaki, "Miracle and Physics," The Asbury Theological Journal, vol. 42, no. 1 (1987), 29.

[30]Stix, 98.

Creation research focuses more on interpreting science than on facilitating science. Robert Snow criticizes creation research as a form of Christian sectarianism.[31] Its central problem is to invent a philosophy of science to discount the historical sciences.[32] J. P. Moreland warns of the danger of dogmatically holding to only one understanding in light of the problems of interpreting Genesis 1 and 2.[33] Dogmatism is not a unique trait of young-earth-creationists. Many others in the mainstream scientific community have also faulted in this area. Creationism can be a respectable theory of cosmogony if the creationists are willing to relax their insistence on a young earth paleontology. For instance, God could have created the universe through stages in terms of a multiple-gaps paleontology.[34] This way one can still preserve Biblical creationism in lieu of the incontrovertible evidence in support of an old earth. I vote against young-earth-creationism because it fails to offer a consistent theory of cosmology, not because of its approach or methodology.

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[31]Van Till, 176.

[32]Ibid., 179.

[33]J. P. Moreland, Scaling the Secular City (Grand Rapids: Baker, 1987), 214-223.

[34]Alfred Tang, "The Multiple Gaps Theory: A Contemporary Revision of the Science and Theology of Creation" (M.Div., Talbot School of Theology, 1991), 19-22.

Theistic Evolution as Christianized Secularism

On the opposite end of the spectrum, we have the Christian naturalists who interpret the Genesis accounts solely in terms of the evolutionary paleontology. Many of them are members of the American Scientific Affiliation. Well known works from this group are Pattle P. T. Pun's Evolution: Nature & Scripture in Conflict? and Howard Van Till's Portraits of Creation. Theistic evolutionists adopt a very similar paleontological schedule as their secular counterparts, with the auxiliary bent of divine sovereignty as a guide of evolution. Theistic evolutionists are readily accepted by their secular colleagues because their theology is a replica of the mainstream scientific philosophy. Van Till's outline of scientific methodology resembles a manifesto of scientism.[35] His program simply Christianizes evolution. In essence, he promotes the view that science dictates theology. Davis Young defines the thesis of theistic evolution as follow,

> Contrary to the view held by many Christians, we believe that historical reconstructions by modern astronomy and geology are neither uncontrolled speculations nor founded upon unbiblical presuppositions. We hold that these reconstructions are firmly grounded in a wealth of carefully gathered data and have been repeatedly tested by the respected canons of science.[36]

[35]Van Till, 126-165.

[36]Ibid., 11.

One can see a pejorative motivation within the program of theistic evolution, which bases the epistemological ground of its entire interpretative strategy on scientific data alone. I need to clarify that science must *ipso facto* have an impact on theology at some point. What I do not agree is the audacious view that theology ought to be taken as a branch of science. For instance, I object to Frank Tipler's claim that theology will eventually become a branch of physics and that the highest intellectual achievements are ultimately reducible to physics.[37] Scientism is the basic worldview of most process thinkers and evolutionists. It is clear that a thread of scientism runs through most of the writings of theistic evolutionists. This kind of empirical prejudice creates an asymmetry which makes the sincerity of Christianized evolution a suspect.

Ecumenical Movement

There is a recent movement led by the Vatican to initiate a dialogue between science, philosophy and theology. In September 1987, a Study Week was held at Castelgandolfo in which papers were presented from an eclectic group of experts constituted of atheists, agnostics, process thinkers

[37]Frank J. Tipler, The Physics of Immortality (New York: Doubleday, 1994), 328-329.

as well as mainstream Christians. In the address to the conference, Pope John Paul II states the Catholic position on the relationship between science and theology as follow,

> Yet the unity that we seek, as we have already stressed, is not identity. The Church does not propose that science should become religion or religion science. On the contrary, unity always presupposes the diversity and the integrity of its elements. … To be more specific, both religion and science must preserve their autonomy and their distinctiveness. Religion is not founded on science nor is science an extension of religion. Each should possesses its own principles, its pattern of procedures, its diversities of interpretation and its own conclusions.[38]

Pope John Paul's statement is an embodiment of the ecumenical spirit which seeks to restore a unity in terms of peaceful coexistence and a respect for the indigenousness of each subculture. The ecumenical movement is in essence an effort aimed at rallying a political unity in a fragmented world. Its goal may be novel and its actions can be efficacious in meeting some short term political objectives. Unfortunately its compartmentalized thinking is against the genre of a profound integration between science and theology. The demarcation between science and religion which the Pope emphasizes presupposes a basic distinction between theological and scientific knowledge. This presupposition is unjustified. Both science and theology

[38]Robert J. Russell, William R. Stoeger and George V. Coyne, Physics, Philosophy, and Theology: A Common Quest for Understanding (Vatican City: Vatican Observatory, 1988), M8-M9.

aim to seek truth from different perspectives. Science focuses its attention primarily on physical data while theology on the other hand extracts spiritual truths from special revelation and *a priori* reason. Although the two disciplines are conducted in different realms of reality, they share a common goal to know truth. If truth has a unified structure, variant aspects of it will ultimately converge at some points. The Catholic view of demarcation has no metaphysical validity. Its staunch rejection of a theologio-scientific union is a suspect of religious protectionism. Its insistence is arbitrary and in direct opposition to the thinking of many of the leading theologians such as Torrance as well as the founding fathers of modern science, like Einstein and Maxwell. Ironically, Pope John Paul's demarcated view of science and religion seems to contradict Pope Pius XII's position when he in 1951 Christianized the Big Bang theory as a Catholic doctrine.[39] This kind of contradiction between different generations of papal successors leads one to question if there is a genuinely dogmatic Catholic philosophy regarding the integration of science and theology.

There were two renowned physicists who presented papers at the Study Week in Castelgandolfo, J. C. Polkinghorne and Frank Tipler. Polkinghorne has made important contributions to the field of particle theory

[39]Ibid., 329.

in his earlier years and later became a trained theologian. He is the first prominent physicist who openly questions the foundation of quantum physics. His controversial book The Quantum World is the first in a line of critical challenges against the philosophical principles of quantum mechanics. In his address in the Study Week, he endorsed the reality of the quantum world while rejecting Bohr's Copenhagen positivism.[40] He emphatically denies that quantum theory supports Eastern mysticism as Zukav and Capra have suggested.[41] Polkinghorne seems to concur with Einstein's judgment that quantum theory is merely an incomplete description of Nature. The Copenhagen school of positivism is an amalgam of Kierkegaard's existential philosophy and physical empiricism. Bohr's categorical denial of quantum reality opens the door to mysticism and diminishes the coherence of the operative principle behind the creation. Positivism has no place in the theology of science.

Frank Tipler on the other hand endorses positivism as a kind of process philosophy. Tipler in his worldwide bestseller The Physics of Immortality outlines a physical theory of eternity, resurrection and God. He

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[40]Ibid., 336.

[41]Ibid., 340.

gave a précis of his book in the Study Week.[42] His main thesis is that the universe is closed and that the human soul is essentially a computer program. At the Big Crunch, the entire universe with all of its information collapses into a singularity. Tipler borrows Teilhard de Chardin's terminology "the omega point" to refer to this final fate of the universe. In Tipler's thinking, eternity is time slowed to a virtual halt on the c-boundary of the Big Crunch singularity. The c-boundary is the light cone which separates what is physically reachable from what is unreachable in the spacetime region.[43] Tipler's eternity is functionally identical to timelessness. In the final stage of the universe, God evolves toward the omega point. The process thinking hidden behind the physics of immortality is consistent with Tipler's earlier work co-authored with John Barrow The Anthropic Cosmological Principle in which the universe is also said to be evolving toward an omega point.[44] Process theology is mostly an naturalistic theory which aims to harmonize theology and the evolutionary theory. The transcendent God is not subject to the evolutionary forces of the universe. Even if we grant that the universe is evolving, there is no reason

[42]Ibid., 313-331.

[43]Tipler, 131.

[44]John D. Barrow and Frank J. Tipler, The Anthropic Cosmological Principle (Oxford: Oxford, 1986), 673.

why God must also evolve along with it. It is not to mention that macro-evolution is already an outdated scientific theory. Therefore, Tipler, and many other process thinkers like him, have exchanged science for scientism.

T. F. Torrance on Science and Theology

Among the theologians of the 20th century, the Scottish Reformed theologian, T. F. Torrance, stands out as the most informed and prolific contributor to the dialogue between science and theology. Torrance is well known for his scientific and philosophical theology, even though his main theological work and interest is in the field of Christology and soteriology.[45] Torrance prefers positive theology over systematic theology in that the former seeks to integrate the existential reality with the formal inquiry of theology while the latter tends to focus on systematizing thoughts only. On the nature of scientific knowledge, he believes that formal definition alone is inadequate; one must also rely on informal knowledge to know reality.

> Thus, in any formally defined knowledge we rely upon informal knowledge of something else which means that we cannot use formal statements alone separated from the informal assumptions that regulate their function.[46]

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[45]Robert J. Palma, "Thomas F. Torrance's Reformed Theology," Reformed Review, vol. 38, no. 1 (Autumn 1984), 5.

[46]T. F. Torrance, "Realism and Openness in Scientific Inquiry," Zygon, vol. 23, no. 2 (June 1988), 164.

Formal knowledge is a set of analytical definitions. An example is the mathematical formalism in physics. Informal knowledge is intuition, the Kantian synthetic *a priori* knowledge. Torrance's scientific epistemology is similar to Karl Popper in that Torrance thinks that analytic statements alone cannot lead to the knowledge of what is true, only what is false. Popper similarly believes that science as an enterprise with all its empirical tools can only disprove incorrect scientific theories. Torrance calls his approach the *apophatic logic*. An example of apophatic logic used in theology is the saying that *we cannot know what God is but only what he is not.*[47] In science, apophatic logic creates an open-endedness that can only be closed by a "leap of faith." One can argue that cosmologists standing on the edge of the universe are most prone to religiosity. As Einstein was confounded by the inner reason of physical laws, for he "declined to suspend judgment, to rein back the forward leap of his mind in a kind of *epoché* at the way things actually are; instead he projected his thought onto religious ground, for it is there he instinctively felt that the ultimate center unifying all scientific laws is to be found."[48] Torrance believes that the contingent order

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[47]Ibid., 162.

[48]Ibid., 166.

of the universe cannot be construed merely in terms of chance and necessity, or statistical probabilities, but must be understood finally out of its inner relation to the creative and the ordering force of the Word of God.[49]

The "leap of faith" in Torrance's scientific openness is not to be confused as a branch of Kierkegaard's existentialism. Torrance is a realist. His realism follows from the unitary character of his theology. He states that "as rational beings we operate instinctively with a belief in the reality of the external world independent of our perceptions."[50] He clearly affirms the reality of the triune God and his acts independent of human cognition.

Torrance's view of scientific openness, though on the surface has the luster of correctness, is question begging under perusal. The mystical feelings wrought at the end of reason is indeed intoxicating and romantic. But the question remains: "How do we know that we are at the end of reason?" After Newton had formulated his universal law of gravitation, he had thought that the end of scientific inquiry was at hand. Yet history shows that science never ceases to defy finality. Shortly after the Newtonian era was safe, the discovery of quantum mechanics again led the entire scientific enterprise to a new level of awareness. The end of reason is illusive. Now,

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[49]Ibid., 167.

[50]Palma, 17-18.

after decades of mediocre existence, many scientists are once again asking these same soul-searching questions. Is the answer necessarily an existentialist leap of faith? or should we wait for another revolution? Torrance's view of scientific openness is insightful in that not all knowledge is reduced to formal statements. But we must be careful not to misunderstand his reliance on informal knowledge as a "God of the gap" argument. The strength of Torrance's theology is his emphatic reliance on the Word of God and the nature of the triune God; and the weakness is his habitual use of apophatic logic which, by its nature, talks more of what scientific theory is not than what is.

Stanley Jaki's Christology and Science

Jaki, a prominent Catholic historian of science, is known for his insightful work on tracing the influence of Christology in the history of science. His book The Savior of Science explains how the notion of creationism has made a tremendous impact on the development of Western science. A summary of his thesis is succinctly outlined in a précis published in Asbury Theological Journal entitled "Christology and the Birth of Modern Science."

> The birth of science, insofar as it is inconceivable without the birth of the idea of inertial motion, has, as shown by Buridan's very words,

> explicit connection with the idea of creation out of nothing which only a personal, infinitely perfect Creator can perform.[51]

Jaki credited the rapid scientific progress in the West to the influence of the Christian worldview. He claims that a sense of uniform order in the universe, essential to the birth of science, is a unique by-product from the belief of a transcendent Creator. The incarnation of Christ provides the evidence for a reality separate from the physical universe. Transcendence as the foundation of objectivity keeps science from the error of pantheism.

> Herein lies one of the reasons why science failed to arise among the Greeks of old. If all science is cosmology, then all true scientific laws must be equally, that is, consistently valid throughout the universe. In other words, science makes sense only if the universe is uniform ordered. This is an idea that could not arise within Greek paganism or pantheism. But the idea of a consistently or fully-ordered universe is a natural consequence of orthodox Christology.[52]

The influence of Christianity was indubitably prominent in the early history of science. Many of the scientific patriarchs were devoted theists such as Maxwell and Lord Kelvin. Even Newton in his overtly deist outlook was deeply Christian. Jaki's analysis is applicable up to 20th century when a spontaneous shift from Christianity to paganism takes place. The majority of the patriarchs of modern science are paganists, pantheists or atheists.

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[51]Stanley Jaki, "Christology and the Birth of Modern Science," Asbury Theological Journal, vol. 45, no. 2 (1990), 65.

[52]Ibid., 68.

Among them, just to name a few, De Broglie, Eddington and Schröedinger are pantheists, while Dirac, Feynman, Hawking and Weinberg are atheists.

Transcendence, the existence of otherness, is consistent with realism. We can safely assume that Jaki is a realist. The praxis of the philosophy of science is not always realism. For example, Bohr's Copenhagen school of quantum interpretation, inspired by Kierkegaard's bipolar relational logic, is strongly positivistic.[53] Of course one can argue that even anti-realist thinking can be subliminally influenced by transcendence, especially when the language of mathematics used in physical theories is held to be platonic for many years.[54] A famous proponent of the objective reality of mathematics is Gottlob Frege who published his immortal Begriffsschrift in 1879.[55] Today the direction of the philosophy of mathematics has followed the development in physics toward a more positivistic orientation. Both mathematics and physics are benefiting from the residual blessing of a heritage of theological realism. Although Jaki's historical analysis may be oversimplifying, we have to agree that a connection between Christology and science is not exactly farfetched.

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[53]Loder, 62-80.

[54]Philip J. Davis, "Fidelity in Mathematical Discourse: Is One and One Really Two?" New Directions in the Philosophy of Mathematics, edited by Thomas Tymoczko (Boston: Birkhäuser, 1986), 163-176.

J. P. Moreland

There are many different branches of philosophies of science, such as rational realism, constructive empiricism, pragmatism, operationalism, phenomenalism and nonrational non-realism. Moreland classifies himself as a moderate rational realist.[56] He realizes that there are many philosophical difficulties with rational realism even though it is currently a popular form among philosophers of science today. He also emphasizes that one must exercise caution before accepting a current scientific theory which constitutes truth-claims about reality. Moreland denies that a demarcation between science and theology exists and that science is the only discipline capable of truth-seeking.[57]

On integrating theology and science, Moreland tends to view theology as foundational for science,

> Theology provides the metaphysical foundation for science and helps to ground the latter by explaining the necessary preconditions of science. Theology asserts that there is an external world made by the same being who made our sensory and rational faculties and who gave us epistemic and moral values. Theology also asserts that creation was a free act of God, and thus one cannot deduce what the world must be like by a

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[55]Jean van Heijenoort, Frege and Gödel (Cambridge, MA: Harvard, 1970), 1-82.

[56]Moreland, 187.

[57]Ibid., 185-200.

> logical deduction from some first principle about the nature or motives of God. Rather, one must use some sort of inductive method, since creation was free and the world is contingent.[58]

In essence, Moreland claims that theology is propitious to science, but the vice versa is not necessarily true. His criticizes a common view of science that it is delimitative of theology. His view of inerrancy, among other rational justifications, places theology in a more superior hierarchical order over science, even though both science and theology are interacting disciplines aim at understanding the same reality. Regarding integration, Moreland wrote,

> An eclectic model of integration is the most adequate. It recognizes that sometimes the two disciplines are concerned with two distinct realms, sometimes they are noninteracting approaches to the same realm which provides answers to different kinds of questions, sometimes theology provides an adequate worldview consistent with the necessary philosophical presupposition of science, and sometimes they are interacting, competing approaches to natural phenomena.[59]

Moreland's position is diametrically opposed to that of the Vatican and Karl Popper who claim that science and theology are fundamentally demarcated. Both the Pope and Popper err in an oversight of the early history of science in which men of science were also men of theology. I agree with Moreland on the compatibility of science and theology. But I will also say that the

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[58]Ibid., 202-203.

[59]Ibid., 207.

integration of science and theology is indispensable. The reasons for my claim will be developed further in chapter 3.

Bringing Science and Theology Together

Scientists are commonly caricatured as brilliant eccentric hermits in tattered lab coats hidden behind test tubes, electronics and computers. For some ineffable reasons, there is a subconscious tendency to perpetuate this myth even among the scientists themselves. In my own experience, the scientists constitute a group of very socially aware intellectuals. Despite the rumors, many scientists are very interested in philosophical and theological questions. Science spans a spectrum of activities ranging from theoretical research to laboratory science and technology. The kind of science of which we are concerned here is mostly theoretical science because theory is the focus of the philosophy of science.[60] Pure science is essentially cosmology.[61] Theology is also cosmology concerning the God of creation.[62] Since science and theology focus on the same subject matter, namely the universe, they will inevitably converge at some point. The integration of

[60]Van Fraassen, 1-2.

[61]Jaki, "Christology and the Birth of Modern Science," 68.

[62]Carl F. H. Henry, The Christian Mindset in a Secular Society (Portland: Multnomah, 1984), 27.

science and theology is not only an Augustinian ideal[63], it is a *necessity* in the search for knowledge. Einstein believes that it is impossible to conduct science without religion and vice versa. His passion for integration and the logic of its relevance is cogently expressed in many of his essays. He wrote,

> On the other hand, I maintain that the cosmic religious feeling is the strongest and noblest motive for scientific research. Only those who realize the immense efforts and, above all, the devotion without which pioneer work in theoretical science cannot be achieved are able to grasp the strength of the emotion out of which alone such work, remote as it is from the immediate realities of life, can issue. What a deep conviction of the rationality of the universe and what a yearning to understand, were it but a feeble reflection of the mind revealed in this world, Kepler and Newton must have had to enable them to spend years of solitary labor in disentangling the principles of celestial mechanics! Those whose acquaintance with scientific research is derived chiefly from its practical results easily develop a completely false notion of the mentality of the men who, surrounded by a skeptical world, have shown the way to kindred spirits scattered wide through the world and the centuries. Only one who has devoted his life to similar ends can have a vivid realization of what has inspired these men and given them the strength to remain true to their purpose in spite of countless failures. It is cosmic religious feeling that gives a man such strength. A contemporary has said, not unjustly, that in this materialistic age of ours the serious workers are the only profoundly religious people.[64]

Einstein will argue that even the atheist scientists are motivated by a sense of cosmic religious feeling even though they may be quite unaware of it. In light of the common object between scientific passion and religious fervor, the historic conflicts between church leaders and scientists can be seen as

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[63]J. P. Moreland, Christianity and the Nature of Science (Grand Rapids: Baker, 1989), 17.

some unfortunate feuds. Science and theology shall not abandon the hope of a much happier ending in the future. Bernard Ramm affirms the existence of a mutuality between science and theology,

> However, contrary to liberalism, we affirm that the theological does at times overlap the scientific, *e.g.* matter is not eternal but created; the simple preceded the complex in the order of life; man is the latest and the highest creation of God; Jesus was actually born of a virgin; or, the universe will have a demise and make way for the new heavens and the new earth.[65]

Both theology and science are disciplines of rational inquiries. They have a greater commonality than what many are willing to admit. Each is endowed with the genius of great thoughts which are complementary to the other. Their marriage has the auspice of a blissful future.

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[64]Albert Einstein, Ideas and Opinions (New York: Bonanza, 1954), 39-40.

[65]Bernard Ramm, The Christian View of Science and Scripture (Grand Rapids: Eerdmans, 1954), 94.

CHAPTER 3

FUNDAMENTAL CONSIDERATIONS

The human psyche is sometimes driven by the conceit of omniscience to race toward an *opus magnum* on a theory of everything. Other times, it revels in the mysticism of cosmic incomprehensibility and intoxicates itself with a romanticism of benightedness. Philosophers have for centuries tried to explain these mental contradictions. Hegel's synthesis and Kierkegaard's bipolar relational logic are solutions to the contradictory nature of the human logic. Science and theology are human activities which are not free from the enigma of psychological contradictions. Contradictions stand on antitheses. Scientific thinking and religious feeling are antithetical if and only if both cannot logically coexist. But the assumption of this mutual exclusiveness is hasty and presumptuous. Its fallacy can be easily exposed by the lives of countless scientific geniuses who are also deeply religious. Einstein's famous maxim serves as a counter-example, as he wrote, "Science without religion is lame, religion without science is blind."[66]

[66]Albert Einstein, Ideas and Opinions (New York: Bonanza, 1954), 46.

The physical universe provides an immanent base for our sensory experience from which the transcendent reality finds its expressions. Immanence and transcendence can be complementary concepts. John Frame interprets transcendence as a "covenant headship" and immanence "God's covenant involvement with His people."[67] Transcendence is an allusion to the pure existence of God, while immanence is the world-ground. A world-ground is "that Reality lying behind all phenomena."[68] An obsession with creation can mutate into a form of idolatry which will ultimately cloud our transcendental vision. Although concepts of transcendence and immanence are complementary, the former has a hierarchical priority over the latter in Christianity. Jesus often teaches us to turn our eyes to heaven and our backs to the world; He said that one cannot serve both God and mammon (Matt. 6:24; Luke 16:13), that heaven is a more superior "place" than the world (Matt. 16:26; Mark 8:36; Luke 9:25), and that God's children are not of this world (John 12:25; 17:14, 16; 18:36). Although "of this world" (κ˘σμ̓ τοῦτ) used in these verses refers mostly to the ungodly world system and

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[67]John M. Frame, The Doctrine of the Knowledge of God (Grand Rapids: Baker, 1987), 14.

[68]Bernard Ramm, The Christian View of Science and Scripture (Grand Rapids: Eerdmans, 1954), 71.

its evil tendency, the point I wish to make here is that a love of transcendental wisdom is preferred to the love of worldly materialism.

Science with all of its technological advances presents a temptation to exploit Nature for self-gains. Pure science has a higher and nobler goal to seek an understanding of the transcendent Reality through the immanence of sensory experience. To this end, science and religion together must forge an alliance, first, to facilitate a unified field of knowledge, and second, to give us an inner reason of spiritual integrity.

What is Science?

Science as a discipline of collective human activities, like art and music, is not limited by any rigid formalization. Even Einstein, with the disposition of his unusually penetrative mind, was willing to commit to only a general definition of the nature of science, for he wrote,

> Science is the century-old endeavor to bring together by means of systematic thought the perceptible phenomena of this world into as thorough-going an association as possible. To put it boldly, it is the attempt at the posterior reconstruction of existence by the process of conceptualization.[69]

Among the philosophers of science, the answer to the question of what is the nature of science will vary depending on whom we ask. J. P. Moreland, a

[69]Einstein, 44.

rational realist himself, claims that the majority view today is rational realism. [70] Howard Van Till, while he denies any real consensus on an authoritative definition of good scientific investigation, identifies the operative value of the scientific praxis as competence, integrity and sound judgment.[71] However these values are not unique to science, they cannot define science in any meaningful way. Moreland, on the other hand, is not diffident to refute the misconception on the nature of science such as tentativeness, repeatability and testability. He wrote,

> We have seen that a generally agreed on set of necessary and sufficient conditions for something to count as science has not been found. This is why the statement by Larry Laudan at the beginning of the chapter [The victory in the Arkansas case was hollow, for it was achieved only at the expense of perpetuating and canonizing a false stereotype of what science is and now it works.] should serve as a warning to those who attempt to define science so that it is clearly isolated from other disciplines. This popular understanding perpetuates a false notion of what science is and how it works.[72]

Not only arguing the point that a clear-cut definition of science does not exist, Moreland also concludes that theological concerns are important to science at several levels.

> One of the main ways theology interfaces with science is by providing rational conceptual problems for scientific theories. This often is

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[70]J. P. Moreland, Scaling the Secular City (Grand Rapids: Baker, 1987), 188.

[71]Howard J. Van Till, Portraits of Creation (Grand Rapids: Eerdmans, 1990), 136-147.

[72]J. P. Moreland, Christianity and the Nature of Science (Grand Rapids: Baker, 1989), 42.

> achieved via philosophy; for example, the theological concept of God as Creator is studied as philosophical concept (an agent who acts in various ways that can be specified and from which conceptual and empirical implications for science can be drawn). In general, the integration of science and theology is a philosophical question.[73]

If Moreland is right about the non-existence of a clear demarcation between science and theology, then it is plausible for theology to be scientific and science to be theological at some levels.[74] His remark that theology can inform but is not delimited by science implies that theology supersedes science in hierarchical order. By "hierarchical order," I mean that the philosophical substrata of science is a subset of the nexus of theology. This way, we can argue that philosophy affects theology, and theology in turn influences science. According to this judgment, the integration of science and philosophical theology is not only a natural consequence but a logical necessity.

Science and Epistemology

Science is epistemology in the sense that its purpose is to know truth. There is a common misunderstanding that science is enshrined in a set of well defined principles and techniques to unlock all empirical secrets. In this following section, I hope to dispel some of the myths about the scientific

[73]Ibid., 57.

[74]Ibid., 99-100.

methods. I also want to show that scientific knowledge and religious epistemology are complementary approaches.

A Case for Rational Realism

The principles of falsificationism and justificationism in science presuppose the existence of an objective reality and objective knowledge. Objective reality is the seat of metaphysical realism and objective knowledge the crown of rationality. Together they are the *sine qua non* of rational realism. Realism is taken to signify a belief in the existence of universals.[75] Some proponents of realism are Albert Einstein, J. P. Moreland and T. F. Torrance. Without objective reality and objective knowledge, science is non-operative. A correspondence theory of truth is most compatible with metaphysical realism. The correspondence theory hypothesizes truth as an external true statement pertaining to something that *really* exists out there. Objective reality by definition has independent existence apart of the subject. Objective knowledge, though itself a private property of the knowing subject, is accessible to all knowers who are identically influenced under the same external conditions. According to

[75]Robert J. Palma, "T. F. Torrance's Reformed Theology," Reformed Review, vol. 38, no. 1 (Autumn 1984), 18.

Roderick Chisholm, the objectivity principle states that a proposition is objective if (1) it is either true or false and (2) it can either be known to be true or known to be false.[76] It is clear that this definition is not subject-dependent. Objective knowledge must be equal and communicable.

Science focuses only on objective truths. This belief of the existence of objectivity is consistent with Christian theism. Science as cosmology aims to understand the universe. If God is the Creator and the Lord of the universe, it makes sense that the presuppositions of science must be superimposed with theism. Likewise, if God does not exist, science will then be more appropriately interpreted either through a purely mechanistic or pantheistic worldview. It is to say that science, by its nature of inquiry, cannot avoid the basic question of an underlying religio-philosophical presupposition. Both realism and theism support objective reality. The union of Christian theism and science is guaranteed safety by a mutually agreeable denominator. Realism is the philosophy *par excellence* not only for theology and science singly but also for both of them jointly.

Although rational realism is the norm in the philosophy of science today, there are many philosophers, such as Karl Popper, Thomas Kuhn and Bas Van Fraassen, who challenge different facets of this position. Some of

[76]Roderick M. Chisholm, Theory of Knowledge (New Jersey: Prentice Hall, 1989), 14.

these oppositions will be examined in the next section. Now it suffices to conclude that (1) the integration of science and theology is necessary in the search of a unified field of knowledge and that (2) rational realism is the logical choice of epistemological position for integration.

The Anti-realist's Challenges

One of the most prominent philosophers of science in recent times is Thomas Kuhn, whom Moreland classifies as a nonrational nonrealist.[77] Kuhn sees the development of science as the fluxes of a series of struggle between periods of normal science and crisis. A paradigm shift ensures when current scientific theory fails to explain new experimental data. New theories are needed to explain the data. A shift occurs when existing theories are replaced with new theories of greater explanatory power. The shift can take place without any intervention of discoverable rules, interpretation or rationalization of it.[78] Kuhn's relativistic argument is cogently challenged by Karl Popper.[79] The exchange between the two philosophers survives as an interesting historical anecdote

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[77]Moreland, Scaling the Secular City, 194.

[78]Thomas S. Kuhn, The Structure of Scientific Revolution (Chicago: Chicago, 1970), 44-46.

[79]Moreland, Christianity and the Nature of Science, 198-202.

The Austrian born philosopher Sir Karl Popper is the most widely acclaimed philosopher of science today. Popper is sometimes mistaken as a positivist. On the contrary, his philosophy radically deviates from logical positivism in that his view of falsificationism directly contradicts the positivist belief that scientific methodology and verifiability are the only means of knowledge. It is difficult to classify his eclectic philosophy. Moreland identifies him as a realist.[80] However there are also times when Popper sounds suspiciously like a non-realist. His position, to my best estimate, can be thought of as a hybrid between Einstein's realism and Niels Bohr's Copenhagen positivism. In an interview with a Scientific American journalist John Hogan, Popper, though at once confessing the existence of objective reality, admits that we will never be able to know it.[81] He separates science and non-science through the irrevocable demarcation introduced by the criterion of falsifiability.[82] Popper is most famous for his view on falsificationism which states that scientific testing cannot give positive evidence of a theory, they can only serve to falsify or refute it.[83]

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[80]Ibid., 142.

[81]John Hogan, The End of Science (Reading, MA: Addison-Wesley, 1996), 37.

[82]Karl Popper, The Logic of Scientific Discovery (London: Routledge, 1980), 40-42.

[83]Karl Popper, Conjectures and Refutations (New York: Harper, 1963), 33-65.

His thesis is an ambush for novice philosophers who try to refute it simple-mindedly by the consideration of self-refutation. If one asserts that falsificationism is itself not falsifiable, Popper will rebuke his naïveté with an superior air of condescension mingled with a devilish satisfaction. He will say that falsificationism is not itself a scientific statement and therefore is not subject to the same standard.[84] In other words, the novice's mistake is a categorical fallacy.

Refutations of the arguments of Kuhn and Popper exude from Moreland's books Scaling the Secular City and Christianity and the Nature of Science. Those who are interested in these philosophical arguments are advised to seek informed bibliographic accounts there. For the purpose of this thesis, it suffices to say that a God-centered worldview automatically presupposes realism. Atheists do not believe in transcendence. Their philosophies are closed in systems of analytical formalism. Gödel's incompleteness theorem proves that formal statements alone are insufficient to obtain knowledge.[85] In the absence of transcendence and leaps of faith, simple reliance on analytical statements will only lead to meaningless relativism and tautology. It can be said that the despair of postmodernism is

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[84]Hogan, 38.

[85]Jean van Heijenoort, Frege and Gödel (Cambridge, MA: Harvard, 1970), 83-108. A. W. Moore, The Infinite (London: Routledge, 1990), 172-182.

a developmental offspring of anti-realism. As theists, we want to give meanings and values to our worldview. Rational realism is the only viable option. Our approach to science should be one which aims at understanding God and His creation and seeks to give rational expressions of our religious beliefs. As Torrance has said, "Nature itself is dumb, but it is man's part to bring it to word, to be its mouth through which the whole universe gives voice to the glory and majesty of the living God."[86]

Practical Epistemology

Analytical philosophy serves to clarify thinking and categorize ideas. Once we have established the rational realist foundation, the next question is focused on how we may implement our idealist theology in the scientific enterprise.

From our previous discussions, it is clear that we must transcend the rigid delimitation of analyticity to facilitate knowledge. The kind of inductivism so ingrained in scientific thinking by itself will only lead to an infinite regress or circularity. The goal of science is to explain the physical phenomena. By explaining, we mean the process by which we identify the

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[86]Thomas F. Torrance, "Newton, Einstein and Scientific Theology," Religious Studies, vol. 8, no. 3 (1972), 233.

cause of one phenomenon by another more fundamental phenomenon. Alan Padgett explains,

> Not all scientific explanation is causal, but causation is an integral element in explanation in the sciences. This is, of course, not the only way to understand scientific explanation in the sciences, but it is the most promising view, as well as the one in accord with common sense.[87]

If explanation is the act of tracing a chain of causality, the process will in principle either continue *ad infinitum* or terminate. In the first case, we have an infinite regress which is so unrealizable that the present phenomenon can never be "reached." In the second case, we reach an end of the inductive chain which signals an end of reason. This disjunction forces one to make a choice between a transcendental leap of faith or to succumb to some form of pantheism. The latter is untenable because it attempts an Hegelian synthesis of the concepts of transcendence and immanence simply by erasing their difference claiming that "God is the world." I believe that transcendence and immanence are complementary, but I prefer to affirm their basic distinction. By the process of elimination, if pantheism is not a viable option, the leap of faith is the only alternative. By the "leap of faith," I am not referring to existentialism proper, but a transmutation from thinking

[87]Alan G. Padgett, "The Mutuality of Theology and Science: An Example from Time and Thermodynamics," Christian Scholar's Review, vol. 16, no. 1 (Fall 1996), 16.

immanently to transcendentally. The existential anti-rationalism is an undesirable by-product of exhorting transcendence at the expense of immanence. An analytic formalism based on sense experience, *i.e.* science, is a necessary but not sufficient condition to know the ultimate Truth. By denying reason, I think that the existentialists are throwing the epistemological baby out with the bath water. The crisis at the end of inductive reasoning gives evidence to the possibility that immanence (the realm of science) calls for transcendence (the realm of theology). In other words, immanence leads to transcendence, but transcendence explains immanence. Both are mutually dependent in terms of facilitating practical epistemology. One cannot be complete without the other. On the importance of the mutuality of science and theology, Padgett wrote,

> Christian theology has provided the intellectual environment out of which natural science was able to develop. By founding a worldview in which reason and order were understood to be built into the world by a rational God, theology created the intellectual nursery in which early modern science was born and raised.[88]

Along the same line of thought, T. F. Torrance also wrote,

> Similarly, I would argue, natural theology must be brought within the heart of positive theology, where of course its structure will change, for then physical statements and theological statements will be intimately correlated.[89]

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[88]Ibid., 14.

[89]Torrance, 249.

Natural theology in Torrance's use is synonymous with science. Positive theology is facilitated by the "leap of faith" in proper places. In short, I argue that a transcendental leap is tantamount in elevating formal reasoning to an abstract idealist knowledge of ultimate Reality.

The next logical step after the justification of the transcendental leap is the identification of its methods. Many philosophers have, without the awareness of doing so, tried to propose extra-physical standards to facilitate knowledge. The criterion of common sense is a widely practiced *prima facie* standard of judgment in the scientific community. Common sense is known to be wrong in occasions by yielding false conclusions. Common sense finds its objects in our daily experiences. Its validity is questionable in science when the realm of investigation is far removed from our everyday lives. Robert Oppenheimer says,

> Common sense is wrong only if it insists that what is familiar must be reappear in what is unfamiliar. It is wrong only if it leads us to expect that every country that we visit is like the last country we saw. Common sense, as the common heritage from the millennia of common life, may lead us into error if we wholly forget the circumstances to which that common life has been restricted.[90]

[90]J. Robert Oppenheimer, Science and the Common Understanding (New York: Simon and Schuster, 1954), 75.

Sunny Auyang, a field theorist and a philosopher, on the other hand, takes a much more accommodating stance toward the common sensical view. He wrote,

> Some people may object to the emphasis on everyday thinking, arguing that many common notions are discarded by modern physics. The objection is based on the confusion of two types of concepts. We must mark the logical distinction between *substantive* and *general* concepts, or the *substantive content* and the *categorical framework* of a theory. Electron, electrically charged, a dozen, and in between are substantive concepts, which characterize the subject matter of the empirical sciences. Object, property, quantity, and relation are general concepts that constitute the categorical framework within which the substantive contents are acknowledged as descriptive of the world. The elucidation of the categorical framework belongs to philosophy, which is not concerned with the specific features but with the general nature of the world and the modes of our knowledge of it. Modern physical theories introduce radically new substantive concepts but maintain the continuity of the categorical framework. They do not overthrow general common concepts but rethink them and make them their own, effectively clarifying and reinforcing them.[91]

The normal semantic range of "common sense" refers to the type of general cumulative knowledge which is sensible and respectable. The opposite of common sense is bizarre speculation and ingenuous madness. Given this definition, it is unclear how his distinction of substantive content and categorical framework improves the status of common notions. Auyang admits the possibility of common sense being mistaken in its substantive content. However, the substantive content is *ipso facto* the object of

[91]Sunny Y. Auyang, How is Quantum Field Theory Possible? (New York: Oxford, 1995), 12.

scientific investigation. Although I agree that our knowledge of the world is continuously refined by new data, the central issue of epistemology is how we know what we think we know is true. Auyang simply brushes off the question and supplies an unrelated category which also turns out to be self-defeating. Hence his elucidation is a *non sequitur* at best.

Common sense, intuition, *a priori* and *prima facie* knowledge can all be the starting points of formal inquiries. However knowledge does not end there. Modern physics has taught us a humbling lesson in that Nature is full of counter-intuitive surprises. Special relativity and quantum mechanics have exemplified a defiance of the common sensical notion of a universe familiar to our everyday senses. History has demonstrated that common notions alone are not enough to guide us into the inner mysteries of Nature. Indeed the motto of the scientific revolution is a shift from *a priori* to *a posteriori* reasoning. However, even in the age of science, we can still be tempted by the conceit of omniscience when we feel most assured of our intuitive intelligence. Jaki calls *a priori* thinking a product of pride.[92] Our common sense experience encompasses only a infinitesimal fraction of all of the information contained in the vast universe. Those who are intellectually

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[92]Stanley L. Jaki, The Savior of Science (Washington, D.C.: Regnery Gateway, 1988), 90.

honest will willingly accept the inadequacy of their inner perception. The greatest thinkers often exemplify the greatest humility in that they are not ashamed of a public display of their ignorance and an awe of the superior intelligence that searches throughout the ineffable mystery of the universe.

Human intelligence is highly esteemed in the scientific community, especially in the traditionally "smart" disciplines such as mathematics and physics. There is a prevalent, however erroneous, notion among the intelligentsia that scientific creativity has a direct correlation to intelligence. Psychologists have studied the structure of creative minds for many years. They conclude that creativity is not the same as intelligence even though the two traits are correlated. When talented individuals are examined, it is found that psychometric creativity is independent of psychometric intelligence, once a threshold IQ of 120 has been reached.[93] Intelligence, however essential to academic activities, by itself does not guarantee the making of earth shattering discoveries like the theory of special relativity.

What we call "discovery" is what Einstein calls "free invention."[94] There is always an element of creativity in truth seeking. It does not imply that truth is a mere imaginative contrivance. Nevertheless the process of

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[93]Howard Gardner, Creating Minds (New York: Harper Collins, 1993), 20.

[94]Einstein, 322.

finding absolute truth is irrevocably a touchstone of creativity. Psychologist Howard Gardner defines a creative individual as "a person who regularly solves problems, fashions products, or defines new questions in a domain in a way that is initially considered novel but that ultimately becomes accepted in a particular cultural setting."[95] Traditionally, there are many different approaches to study the creative minds, such as the cognitive approaches, approaches in terms of personality and motivation, and the historimetric approach. Typically, creative individuals are thought to be independent, self-confident, unconventional, alert, aware of unconscious processes, disdainful of banality, ambitious, and committed to work. Psychologist Mihaly Csikszentmihalyi describes a highly sought-after affective state of extremely motivated creative persons as the "flow state" or "flow experience." A flow state is a peak experience. The prospect of such "periods of flow" can be so intense that individuals will exert considerable practice and effort, and even tolerate physical or psychological pain, in pursuit thereof. An example of the pain of creative intensity is the Russian born physicist Andrei Linde, who is one of the inventors of the Inflationary Big Bang theory. Linde's life history is riddled with anxiety and depression from thinking excessively about his work. It is told that he developed ulcers

[95]Gardner, 35.

from pondering the nature of inflation so obsessively. Once he had fallen into a gloom so deep that he had difficulty getting out of bed.[96] Many psychologists have succeeded at identifying the marks of geniuses. But as far as the origin of their creative talents is concerned, it is still a mystery.

Gardner's psychometric approach is a refinement and synthesis of traditional frameworks. He believes that mastery of a field is indispensable despite a prodigious endowment.

> No matter how potent such an intoxication, at least ten years of steady work at a discipline or craft seem required before that métier has been mastered. The capacity to take a creative turn requires just such mastery, and according, significant breakthroughs can rarely be documented before a decade of sustained activity has been accomplished.[97]

Gardner notices a link between early childhood questions and mature adult achievement. Einstein, as a young boy, had begun to ask questions about the nature of light. It is not surprising that one of his monumental achievements is the formulation of the Lorentz invariance of Maxwell's equations. Individuals who ultimately make creative breakthroughs tend from their earliest days to be explorers, innovators, tinkerers. Gardner's unique

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[96]Hogan, 100.

[97]Gardner, 32.

contribution to understanding the dynamics of creative minds is what he calls the "fruitful asynchrony." He explains,

> In using the term *asynchrony,* I refer to a lack of fit, an unusual pattern, or an irregularity within the creativity triangle. Asynchrony within a node occurs when there is an unusual pattern at one of the three nodes. For instance, there may be an unusual profile of intelligences within an individual (as when the young Picasso displayed precocious spatial intelligence but very meager scholastic intelligences); a domain that is experiencing a large amount of tension (as when different schools of music were vying for hegemony in Stravinsky's time); or a field that is just beginning to shift in a new direction (as occurred when certain enterprising critics emerged around the time modern dance was taking form).[98]

Psychometric frameworks are limited to primarily phenomenological descriptions of creativity. They are viable supplementary information to epistemological discourses, but they alone cannot answer the urgent questions of how such creativity is achieved. At this point, we are ready to return to the final epistemological considerations which I hope can provide the answer.

In Gardner's biographical analysis of many exceptionally talented individuals, he observes an ubiquitous duality of intuition and development. In the arguments of my thesis, intuition is a kind of *a priori* knowledge and development *a posteriori* knowledge. Einstein, though exhibiting traits of an unusual mind since his childhood, was notorious for his early

[98]Ibid., 41.

impediments such as late speech, dyslexia and dubious academic achievement. However he regularly let the nature of his inquisitive mind take its course throughout his adolescence and adulthood. It was after many years of growth and development that his genius finally began to blossom. Gifted children constitute the most misunderstood group of the society. Gardner observes that "Not even prodigies are born whole!" He identifies a general trait in the development of creative geniuses,

> But in my own view, it is a particular combination of youth and maturity that allows the most revolutionary work to take place in the sciences, and such an amalgam can only occur during a relatively small window of the life span.[99]

"A relatively small window of life span" generally coincides with the prime of a creative person's life. The practitioners of physics perpetuate the myth that the most important work of a theoretical physicist is done before the age of 25. Physicist-theologian J. C. Polkinghorne, who invented the S-matrix in particle field theory, once said that mathematical physics is the game of the young men. Einstein had also said, "Discovery in the grand manner is for young people … and hence for me a thing of the past."[100] The "small window" in Gardner's terms is the crossroads between the invincible

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[99]Ibid., 126.

[100]Banesh Hoffmann, Albert Einstein: Creator and Rebel (New York: Plume, 1972), 222.

intuitive youth and the sedate adept adult in one's developmental history. The evanescence of this golden window captures a glimpse of the transitory phase in which experience (*a posteriori* knowledge) has just begun to preside over intuition (*a priori* knowledge) before the metamorphosis is consummated. The mutual exclusiveness between youth and experience, *a priori* and *a posteriori*, is often quietly affirmed, and occasionally openly acknowledged in our society. Yet it is my opinion that the two can coexist. I think the reason for the transition is that, as a person ages, his experience has from time to time proven his intuition wrong. The defeat of intuitive reason causes one to lose faith in his raw ability and rely more and more on his learning. Consequently he becomes less and less willing to follow his intuition to make leaps of faith. Yet, according to Gardner's biographical data, it is exactly the amalgam of youthful intuition and mature adeptness that promotes the longevity of the flow state.

A priori and *a posteriori* knowledge are not diametrically opposed to each other. *A priori* propositions are necessarily true and such that, once one understands them, one *sees* that they are true without proof. *A posteriori* truths on the other hand are truths of facts. [101] In Kant's words, "Only pure intuitions and pure conceptions are possible *à priori*; the empirical only *à*

[101]Chisholm, 26-27.

posteriori."[102] He is the first to coin the term "synthetic *a priori*," and says that our *a priori* knowledge, like all other knowledge, "begins with experience" but that, unlike our *a posteriori* knowledge, it does not "arise out of experience."[103] *A priori* and *a posteriori* may differ in their sources. They are not opposite in meaning. In fact, they must operate in conjunction with each other. Kant also said,

> Our knowledge springs from two main sources in the mind, the first of which is the faculty or power of receiving representations (receptivity for impressions); the second is the power of cognizing by means of these representations (spontaneity in the production of conceptions). Through the first an object is given to us; through the second, it is, in relation to the representation (which is a mere determination of the mind), thought. Intuition and conceptions constitute, therefore, the elements of all our knowledge, so that neither conceptions without an intuition in some way corresponding to them, nor intuition without conceptions, can afford us a cognition.[104]

For instance, in solving a difficult problem, a theoretical physicist may have to formulate the solution from first principles. This way, he first proceeds from his *a priori* intuition and then rallies the proper *a posteriori* facts. Next he forms a representation which aims to cognize and to extend the inner reasons of his mental world in relation to physical observables. The new

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[102]Immanuel Kant, Critique of Pure Reason, translated by J. M. D. Meiklejohn (New York: Willey, 1943), 44.

[103]Chisholm, 31.

[104]Kant, 44.

concept must survive the usual scientific scrutiny in terms of verifiability, unity, simplicity and so forth in order to be accepted as *bona fide* knowledge *a posteriori*. New understanding is neither trivial nor automatic. Even the most highly esteemed physicists are known to have produced more bad works that have long been ignored as well as more good works that are esteemed by posterity.[105] In the case of a failed concept, defective sensibility, either *a priori* or *a posteriori*, and shoddy logic are the blame. Knowledge is derived from both sensibility and logic according to Kant.

> We apply the term *sensibility* to the receptivity of the mind for impressions, in so far as it is in some way affected; and, on the other hand, we call the faculty of spontaneously producing representations, or spontaneity of cognition, *understanding*. Our nature is so constituted, that intuition with us never can be other than sensuous, that is, it contains only the mode in which we are affected by objects. On the other hand, the faculty of thinking the object of sensuous intuition, is the understanding. Neither of these faculties has a preference over the other. … Thoughts without content are void; intuitions without conceptions, blind. … Understanding cannot intuite, and sensuous faculty cannot think. In no other way than from the united operation of both, can knowledge arise. … We therefore distinguish the science of the laws of sensibility, that is, Æsthethic, from the science of the laws of the understanding, that is, Logic.[106]

[105]Gardner, 27.

[106]Kant, 45.

Kant's use of the word "affected" (*afficirt wird* [107]) alludes to a kind of modification—not causation as in *verursachen wird*. "Afficirt" is not a German word. Kant might have adopted it from the Latin *facere* which means "to do." Thus *afficirt wird* purports a semantic meaning of "is done to" or "is modified." His view that sensibility and *a priori* impressions are affected or modified by objects is consistent with his theory of synthetic *a priori* knowledge. Pure intuitions are "valid only for objects of possible experience."[108] Transcendental ideals are excluded from the category of the "possible experience" and therefore are not permitted in sensuous intuition according to Kant.

However Kant is careful not to relate objects as the cause of intuition. Objects are instrumental, not originative, to receiving impressions. Intuition is indeed mystical in that it is not derived from anything—having no logical nor ontic antecedent. It is just there at our disposal in the time of need. Gödel's theorem along with the philosophies of Kierkegaard, Torrance and Popper unanimously agree that knowledge is not closed under analytical statements. Knowledge must be punctuated with and hypothesized by

[107]"Wollen mir die Receptibität unferes Gemüths, Borstellungen zu empfangen, sofern es auf irgend eine Weise afficirt wird," Immanuel Kant, Kritik der Reinen Vernunft (Leipzig: Drud und Berlag bon Philipp Reclam jun, 1781), 76.

[108]Kant, Critique of Pure Reason, 43.

intuition in the chain of reason. In this case, intuition cannot be reduced to objects. Otherwise, we would have arrived at the absurd consequence of reducing the knowing mind to objects. Furthermore, if intuition were caused by or logically posterior to objects, then it is not *a priori*, but *a posteriori*. For intuition to be properly *a priori*, it must be uncaused. The origin of *a priori* knowledge has the auspice of other-worldliness. Knowledge begins and ends in intuition which is not reducible to immanent objects. Therefore, intuition must be transcendental. Despite his disdain toward religion and his advocate for scientific objectivity, Kant ironically refers to his metaphysics of intuition as "transcendental" aesthetics.

From a rational realist point of view, knowledge must correspond with reality. There are three main rival theories of reality—theism, pantheism and atheism. All these, except theism, deny transcendence. By the process of elimination, *a priori* intuition, which is a necessary component of knowledge, is only possible in a theistic framework. Epistemology in pantheistic or atheistic discourses must categorically suppress any talk of transcendence. By doing so, they distort the very structure of knowledge and impede their own progress. This final judgment is a more elaborated analytical rendition of Jaki's history of science which credits the success of Western science to the environment of Christian theism which gives it its

metaphysical framework. In summary, Christian theism with its unique transcendental outlook is not just a nicety, but a *necessity*, in scientific epistemology.

In the age of technology, people are obsessed with methods. Engineering knowledge is commonly exploited as a means of power and control. The universe, as a representation of God's glory, is beyond the grasp of crass materialists. Pure science, as a living discipline of truth seeking, has traditionally resisted the ill of materialism. The ubiquitous phenomena of religious feelings among the greatest minds in science is a testimony of the reverence which Nature invokes. Here I will follow the tradition of modesty by not attempting the arrogance of formulating a methodology of scientific discovery. It suffices to say that it is more important to be the right person than to have the right methods; for the right person will discover the methods, and not vice versa. If the universe is created and governed by an intelligent and good God who gives wisdom to those He loves (1 Kgs. 4:29-34; Prov. 2:6; Dan. 2:21-23; Luke 21:15; Acts 6:3-10; Eph. 1:17; Rev. 5:12, 7:12), then it is expedient to ally ourselves with God and to become a holy people to court His favors, not just for the sake of knowledge but our sanctification as well.

Wisdom has a wider range of meaning than mere cognition. Israelite wisdom (חָכְמָה) is defined as the practical knowledge which enables a man to live his allotted span in the greatest possible harmony with his fellow men and with the world. At its most exalted, wisdom is the order or plan with which God created the world, and by which he continues to regulate its movements. The Greek concept of wisdom (σοφία) centers around the secret knowledge of God and purpose for the world and mankind that the NT chiefly presupposes.[109] According to Georg Fohrer,

> In general σοφα denotes a materially complete and hence unusual knowledge and ability. In the early Greek period any practical skill of this kind counted as wisdom, then during the classical period the range of meaning was strongly restricted to theoretical and intellectual knowledge, and finally in the usage of the philosophical schools of Hellenism and later antiquity the practical element was united again with the theoretical in the ideal picture of the wise man.[110]

The normal semantic range of both the Hebrew חָכְמָה and the Greek σοφία designates a sagacity and knowledge about reality and a skillful living centered around God. The sources of wisdom are (1) the tradition of the fathers, (2) personal experience, (2) instruction and correction, (4) the gift of

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[109]Paul Kevin Meagher, Thomas C. O'Brien, and Consuelo Maria Aherne, Encyclopedia Dictionary of Religion, vol. 3 (Washington, D.C.: Corpus, 1979), 3761-3762.

[110]Gerhard Friedrich and Geoffrey W. Bromiley, Theological Dictionary of the New Testament, vol. 7 (Grand Rapids: Eerdmans, 1971), 467.

God.[111] The first three, such as patriarchal tradition from former generation, wise experience with adequate insights into things and training through proverbs (מָשָׁל), sayings (דָּבָר) and interpretation (פֵּשֶׁר) are useful for pedagogy and practical living which help to dispose one's mind to a degree of clarity in order to receiving divine wisdom. They are nevertheless only very indirectly connected with the actual process of discovering new scientific knowledge. The fourth source of wisdom, the gift of God, is most immediately consistent with the arguments of my thesis purporting to transcendental knowledge as the answer to the limit of analytical reason.

With blessing comes responsibility, the gift of intuitive wisdom needs communicable forms so that it can be put into words or equations. Science can be a kind of such forms. Torrance succinctly captures the spirit of intellectual activities in the motto "science is a religious duty."[112] The gift of wisdom may take place only in specific instances (Gen. 41:16, 38f.; Deut. 34:9; 1 Kgs. 3:12, 28; 5:26; 10:24; 2 Chr. 1:12; Dan. 1:4, 17, 20; 5:11, 14; Jer. 9:11; Job 4:12-21; Isa. 28:26; Ps. 60:7; 94:10; 119:98; Prov. 28:5). In Job 32-37, "The knowledge and teaching which Elihu possesses and wants to impart is described by him as דֵּעַ

[111]Ibid., 492-493.

[112]Torrance, 233.

(knowledge) in 32:6, 10, 17; 36:3 (fem. plur. דְּעוֹת 36:4); materially, however, this is the same as חכמה."[113] Fohrer interprets the significance of this rare word to mean a kind of wisdom that has enduring possession. Hence it is possible that there are at least two senses of the gift of wisdom. The first is that knowledge of particulars is given at specific times, and the second is that knowledge of universal truth is sometimes given for lasting duration. Both senses of the gift of knowledge may contribute to the success of scientific investigation. Truth is not intended to hidden. On the contrary, the Scripture proclaims that "wisdom shouts in the street, she lifts her voice in the square; at the end of the noisy streets she cries out; at the entrance of the gates in the city, she utters her sayings" (Prov. 1:20-21; NASV). From these considerations, we can see that God wishes to and gives knowledge freely to all people in many occasions. But unless there is an openness to receive from the Spirit, the seeds of knowledge will not fall on fertile soil. Sadly, in the secular society, spiritual development is conveniently overlooked in academic pursuits. A respectability of religious feelings in science is virtually nonexistent. It is my opinion that what is most wanting in science is a supply of religious persons. Virtue is as important as

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[113]Friedrich, 493.

intelligence in the quest for knowledge. John Frame believes that obedience to God leads to knowledge. He claims that obedience is knowledge, and knowledge is obedience; the two concepts are synonymous in Scripture. Since unbelievers possess incomplete noumenal contents, their knowledge is falsified by its context.[114] James Clerk Maxwell is known for his devotion to God as well as his field equations of electromagnetism. His personal biographer Lewis Campbell depicts him as an avid church-goer. Maxwell's Christian worldview preserved him from the philosophical errors of the time and leads him toward a positive view on transcendence.[115] In his understanding, science is a tool to theology, for he says, "physical studies lead to spiritual insights."[116] Maxwell's view provides an antecedent for Frame's theology which states that "knowing the world, then, involves knowing the law, and vice versa."[117]

In conclusion, I have shown in this section that practical reason, closed under the analyticity of formal statements, by itself does not lead to Truth. One must first have a sure foundation on reason; but after that, one

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[114]Frame, 40-60.

[115]J. G. Crowther, Men of Science (New York: Norton, 1936), 262.

[116]Ibid., 312; Lewis Campbell and William Garrett, The Life of James Clerk Maxwell (London: Macmillan, 1882), 321-322.

[117]Frame, 68.

needs to transcend reason. Knowledge comes jointly as a product of our own search and as the gift of God. My transcendental view of knowledge differs from the existential leap of faith in that reason and faith do not compete with but complement each other. Intuition guides reason, and reason proves intuition. The triad of *a priori* senses, *a posteriori* knowledge, and logic as guided by faith; and piety is a prerequisite to understand the intelligence that governs the universe. Faith and reason go hand-in-hand in science and religion.

Science and Metaphysics

The realm of the physical universe primarily consists of space, time and matter. An understanding of the three basic elements is essential to science and theology. Einstein has unified space and time in his theory of special relativity. Nowadays space and time are customarily spoken of as one entity in physics. As expected, not every philosopher is willing to accept the relativistic treatment of spacetime. The most common objection to the concept of spacetime is that space is isotropic (the same in all directions), but time is anisotropic (time “flows” in one direction only). Another objection to relativity is based on a property of the Lorentz transformation which gives the appearance that space is time, and time is

space. A common sensical view of space and time is that they are categorically different. The root of both objections ultimately traces back to a belief in absolute space and absolute time which Einstein's special theory ultimately abolishes. In this section, I will try to elucidate the concepts of space and time first as separate entities, then the concept of spacetime as a unity. Following the topics of space and time, I will comment on the nature of mass. Finally, I will conclude this chapter with some very counter-intuitive remarks regarding the nature of the three fundamental units.

The Nature of Time

Traditionally, the process and stasis theories organize the primary definitions of time. Time in the stasis theory (also called the B series time) is "a four dimensional spacetime manifold in which events simply *occur* at various points—they do not come into being nor pass out of being simply because observers identify different times as *now*."[118] In the B series, the history of an object is represented by a spacetime worm. Time exists all at once while the object "moves" through it. For the process theory (also known as the A series), the fundamental nature of things is dynamic. The

[118]Alan Padgett, God, Eternity and the Nature of Time (New York: St. Martin, 1992), 5.

"now" is constantly coming into being and passing out of being. The past is gone, the present is fleeting, and the future is yet to be.

Surprisingly enough, almost a century after the introduction of Einstein's special relativity theory, many philosophers and theologians are still unwilling to jettison the classical Euclidean views of time as having absolute ontology and the arrow of time as a genuine physical phenomenon. The elusive nature of time has been the subject of much debate. Plato identifies time as celestial revolution.[119] Aristotle distinguishes time from movement and change. Time is neither identical with nor independent of change and movement. For Aristotle, time is not a sheer process but a numerable aspect of it. It is a kind of number, "a number of precessions and successions in process and that, since time is a number belonging to something continuous, time is therefore itself continuous."[120] The Greek ideal of timelessness is always present in the writings of the church fathers. Augustine believes that God is timeless in the sense that He is immutable. God does not exist in time, but time in God. Time is not the motion of a body. Time is wholly present and has its absolute existence and duration in

[119]Jefferson Hane Weaver, The World of Physics (New York: Simon and Schuster, 1987), 303.

[120]Ibid., 306.

the mind of God.[121] Augustine's view of time is a version of the stasis theory. His position was highly esteemed in the Western intellectual world until the time of Kant. In his theory of transcendental aesthetics, Kant interprets time as "a pure form of the sensuous intuition."[122] Time is not a real thing but simply a kind of mental property. On the concept of time, Kant wrote,

> 1. Time is not something which subsists of itself, or which inheres in things as an objective determination, and therefore remains, when abstraction is made of the subjective conditions of the intuition of things. … 2. Time is nothing else than the form of the internal sense, that is, of the intuitions of self and of our internal state. … 3. Time is the formal condition *à priori* of all phenomena whatsoever. … And as our intuition is always sensuous, no object ever can be presented to us in experience, which does not come under the conditions of time. On the other hand, we deny to time all claim to absolute reality; that is, we deny that it, without having regard to the form of our sensuous intuition, absolutely inheres in things as a condition or property.[123]

Kant's theory of time as an intuition undermines the traditional notion of absolute time. It sets the stage for an observer-dependent theory of relativity 120 years later. The heart of special relativity is the constancy of the finite speed of light and the invariance of the laws of physics under Lorentz transformation. Relativity is frequently misconstrued to be an evidence of

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[121]Ibid., 367-375.

[122]Kant, 28.

[123]Ibid., 30-31.

relativism when in fact the absolutism in Einstein' thinking is blatantly revealed in the controversy of the Einstein-Bohr debate. Einstein believes that quantum theory is merely "an incomplete representation of *real things*."[124] He freely refers to the existence of a "real external world" in his communications. His realist worldview is easily seen in his writings. For instance, he once wrote,

> … we attribute to this concept of the bodily object a significance, which is to a high degree independent of the sense impressions which originally give rise to it. This is what we mean when we attribute to the bodily object "a real existence."[125]

However Einstein's realism cannot be extended to the concept of time. Time is not a *real* thing. We cannot point to something and call it "time." Time is categorically different from a bodily object and does not entail a real existence. It is also very likely that Einstein is aware of Kant's theory of time since he constantly interacts with Kant's philosophy in his writings.

Time is nothing other than a concept. More specifically, it is a concept of a series of past, present and future moments. We can only possess an elusive sensuous impression of the present; the past is no more and the future is yet to be. Time has an ideal forward impetus. Past, present and future are logically connected in that same order. This connectivity is

[124]Einstein, 315-316.

what we call the arrow of time. Its progression makes sense if and only if the past is distinguishable from the present, and the present from the future. If past, present and future are identical, they lose their distinctions and the sense of movement. In that case, timelessness is implied. If past, present and future repeat themselves periodically, then time can be thought of as moving either forward or backward because time "looks" the same in both directions in the cycles of change. In this situation, time's arrow becomes a taboo and the concept of time loses its essential meaning. The Greeks have proposed theories of cyclic time. However, cyclic time is not time at all as I will show later.

Given the arrow of time, we may ask the question, "Is there a universal time independent of the observer?" or more precisely, "Is the concept of absolute time justified?" Absolute time is defined as a concept of time which has independent existence apart from our sense experience. The absoluteness of time is falsified empirically by special relativity. A counter-example can be constructed to prove my point: Let us suppose that event A and event B occupy absolute times t_a and t_b respectively. By the absolute nature of time, the difference between t_a *and* t_b, which we call Δt, should be the same irrespective of the observer. The invariance of Δt is preserved

[125]Ibid., 291.

under Galilean transformation. Galilean transformation is only an approximation to Lorentz transformation when the velocity of the observer is small compared to the speed of light. Special relativity predicts that Δt is dilated from the point of view of a moving observer. Time dilation is verified to high precision experimentally through the Mössbauer effect.[126] With the aid of modern physics, we can safely reject the concept of absolute time as a relic in the historical showcase of past ideas.

If time does not have any real ontology, it cannot be said to "move" in any real sense of the word. Yet in our everyday language, we say that "time flows." The concept of the arrow of time is a metaphor of our common sensical awareness. Common sense is once again proven wrong. Many people still confuse time with a real object. It is not uncommon to hear an analogy of time told in the form of physical processes. The most frequently cited evidence of the arrow of time as a physical phenomenon is the second law of thermodynamics.[127] The theory of thermodynamics emerged from the studies on heat engines during the Industrial Revolution in Britain. Pre-eminent among the early pioneers was the French engineer Sadi Carnot who

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[126]Sybil P. Parker, McGraw-Hill Encyclopedia of Physics (New York: McGraw-Hill, 1993), 814-8817.

[127]Padgett, 27-35.

provided a penetrating analysis of how the ideal heat engine operated. It was noted that heat must be wasted in the Carnot cycle in order to make efficient the conversion process from heat to work. The second law of thermodynamics was first conceptualized by Rudolf Clausius in 1850 to explain the process of the heat engine and was later given the mathematical expression by Lord Kelvin. In 1865, Clausius sharpened his theory and introduced the term "entropy," a quantity that relentlessly grows with dissipation and attains its maximum value when all potential for further work is spent. According to physicist Peter Coveney, the second law is still somewhat open to interpretation; he says,

> The basic propositions of thermodynamics are rather vague and lend themselves to a great diversity of opinion. … In fact, differences of opinion between scientists are so strong that they often surface as personal sniping and stormy rows. The American philosopher David Hull has recently pointed out physicists can readily compile a list of 20 or more different formulations of the Second Law.[128]

Despite the differing opinions, it suffices to say that most physics textbooks agree to a standard treatment of the second law which states that entropy *S*, a measure of the degree of disorder, always increases in a closed system. The increase of entropy is synonymous with the increase of the number of states in a system. Regarding the arrow of time, Coveney wrote,

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[128]Peter Coveney and Roger Highfield, The Arrow of Time (New York: Fawcett Columbine, 1990), 148.

> Any naturally occurring processes in an isolated system must be accompanied by an increase in the system's entropy, according to the Second Law. Entropy therefore furnishes an arrow of time for all isolated systems.[129]

In essence, an isolated system cannot return to a previous canonical state. The anisotropy of time's progression distinguishes it from the isotropic space. The arrow of time, in terms of thermodynamical considerations, cannot be indefinite. There comes a time when all the free energy in the isolated system is used up. At that point, entropy attains a maximum value and stops increasing. The arrow of time freezes at the moment of heat death. When entropy is maximized, all the possible states in the system are occupied. The system either become motionless or undergoes an indefinite cycle of interchange among existing states. Since the distinction between past, present and future is nullified in both scenarios, neither of them qualifies as having temporal existence.

The second law of thermodynamics is valid only in an isolated system. Since the universe is the only closed system thereof, it behooves us to look at the entropy clock of the universe to get a sense of the arrow of time. Alan Guth, who invented the Big Bang theory, once states that the entropy of the zero-sized gigantic fireball in the Big Bang is infinite. Nobel

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[129]Ibid., 153.

laureate Steven Weinberg specifically calculates that the number density of entropy varies inversely as the cube of the size of the universe.[130] Weinberg in many more words agrees with Guth that entropy is infinite as the size of the universe approaches zero at the Big Bang. If the universe began with infinite entropy, the arrow of time, which relates to the increase of entropy, would have been halted at the very beginning of it because entropy cannot exceed infinity. Yet we sense the circuit of time through past, present and future everyday through the manifold of new movements and changes. In other words, the analogy of the second law breaks down. Perhaps the universe did not begin with an infinite entropy. A few have also argued that the second law cannot apply to any large scale system such as the universe. One way or an other, the belief that time can be reduced to physical processes is insofar bankrupt. In general, time is dependent on change and motion but is not itself change and motion. Time cannot be reduced to any physical phenomenon. The idea that "time is motion" has already been refuted by Aristotle, Augustine and Kant in antiquity. The deployment of the second law of thermodynamics to philosophize time is simply a metaphysical regression.

[130]Steven Weinberg, The First Three Minutes (New York: Basic Books, 1977), 94.

Not only is time not a physical phenomenon, time cannot be an abstract universal either. If time is a universal, it can exist apart from any other concepts. However it is intuitively clear that time depends on the concept of change; time is therefore not a universal. Since time is neither subsisted of any physical objectiveness nor any abstract universal, its absoluteness is a suspect. I have argued before that cyclic time is not time. Time in the case of cyclic motion can have meaning if and only if memory is called into assistance. For the sake of argument, let us imagine a possible world consisting of only two heavy particles connected together by an ideal spring. The system is set into simple harmonic motion which under an idealized situation is capable of perpetuating its motion indefinitely. If memory is removed from the picture, cyclic time results. Each cycle is identical to the other since there is nothing to distinguish one cycle from another. In principle, we can arbitrarily tag a certain phase of a cycle and call it the "beginning" of that cycle in such a way that each cycle has its beginning and end in time. But time so contrived is not time because past, present and future are identical over the periodicity of the cycles. On the other hand, if memory is invoked, we can label the periodic durations as T_1, T_2, T_3, …, and so on. This way, the past, present and future are distinguished, not in the physical process itself *per se*, but in the mind of

observer. This counter-example shows that motion can exist without an arrow of time and that time is not a meaningful concept unless memory is invoked in the process. Motion without an arrow of time contradicts a materialist notion of time and the invocation of memory admits that time depends on mental concepts. Thus time is not a substance nor a physical property. I concur with Kant's transcendental aesthetics in that time is a mental property.

The Nature of Space

Space, being properly isotropic, does not have any arrow. Space, in Greek philosophy, according to Max Jammer, was understood as an infinite void by Democritus. The term "the empty" (κενόν) was often used as a synonym with the word "space" (χώρα).[131] Plato and the Pythagoreans took a geometrical approach to space. Aristotle referred to "space" as the sum of the spaces occupied by all the bodies.[132] Space is defined as the adjacent boundary of the containing body. This definition is consistent with his fundamental assumption of the impossibility of vacuum.[133] Classical

[131]Max Jammer, Concepts of Space (Cambridge, MA: Harvard, 1970), 10-11.

[132]Ibid., 17.

[133]Ibid., 53.

philosophy and science renders space as inhomogeneous and anisotropic.[134] T. F. Torrance concurs with Jammer at most points on the classical history of space. He attributes the origin of the concept of space as a receptacle or a container to the classical Greek period. For Plato, space (χώρα) is spoken as a receptacle (ὑποδοχή) in a metaphorical sense.

> Space is simply that *in which* (ἐν ᾧ) events occur, a formless and passive medium (ἐκμαγεῖον) that does not give shape or determination to what is found within in.[135]

Space along with archetype (παράδειγμα) and copy (μίμημα) helps to bridge the chasm between the realms of the intelligible (νοητά) and the sensible (αἰσθητά). Aristotle develops a volumetric concept of space. He includes the category of quantity (τὸ πόσον or μέγεθος).[136] The final Aristotelian definition of space is the innermost unmoved limit of the container (τὸ τοῦ περιέχοντος πέρας ἀκίνητον πρῶτον).[137] The Stoics regard "body" (that which is) as the active principle of the universe, the source of motion and activity, so that space is construed as the function of body in its determinate extension throughout the cosmos. The principle

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[134]Ibid., 25.

[135]Thomas F. Torrance, Space, Time and Incarnation (London: Oxford, 1969), 4-5.

[136]Ibid., 7.

[137]Ibid., 8.

they formulate is σῶμα διὰ σώματος χωρεί (body extends and makes room for itself through the body). The universe is held together by an interior cohesion (ἕξις) or tension (τόνος) or an immanent reason (λόγος).[138]

Jammer claims that Judeo-Christian theology proves to be the most important factor in the formulation of the theory of space. The first major contributor to the concept of absolute space was Philoponus, or John the Grammarian (575 A.D.). According to Philoponus, the nature of space is to be sought in the tridimensional incorporeal volume extended in length, width and depth.[139] Torrance disagrees with the receptacle theory and emphasizes that Nicene theology does not allow the Aristotelian definition of space, in that all the structured relations within the universe have to be understood dynamically.[140] Thomism later parts with the Nicene theology of space and reverts back to the Aristotelian receptacle theory.[141] Newton, following the footsteps of Medieval metaphysics, thinks of space and time as infinite receptacles.[142] He asserted that space is an attribute of God, or even

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[138]Ibid., 9.

[139]Jammer, 55-56.

[140]Torrance, Space, Time and Incarnation, 11.

[141]Ibid., 25.

[142]Ibid., 38.

identical with God.[143] The notion that God was at one and the same time here and there led to the association of God and space as an expression of his ubiquity. To Newton, absolute space is a logical and ontological necessity. For one thing, it is a necessary requisite of the first law of motion in his Philosophiae Naturalis Principia Mathematica published in 1748, which states that a body will remain in uniform motion or at rest unless a force is acting on it. Rectilinear uniform motion requires a reference system different from that of any arbitrary relative space. Furthermore, the state of rest presupposes such an absolute space. The identification of the omnipresence of space and the omnipresence of God leads to serious difficulty. For instance, by association, the divisibility of absolute space implies the divisibility of God. But omnipresence implies no divisibility of the substance of God. Space on the other hand is divisible into relative spaces.[144] Leibniz wholly supported the Newtonian concept of absolute space and instigated a series of controversies. Huygens, the first physicist who believed in the exclusive validity of kinematic and dynamic relativity two hundred years before the rise of modern relativity, cogently challenged Leibniz's absolutist doctrine.

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[143]Jammer, 28.
[144]Ibid., 116.

It is interesting to note that 33 years after the publication of Newton's Principia, Kant radically revised the notion of absolute space. Absolute space by definition exists apart from any sense experience. According to Kant, space, like time, is not a thing, but a mental property, a synthetic *a priori*,

> 1. Space is not a conception which has been derived from outward experiences. … 2. Space then is a necessary representation *à priori*, which serves for the foundation of all external intuitions. … 3. Space is no discursive, or as we say, general conception of the relations of things, but a pure intuition. … 4. Space is represented as an infinite given quantity.[145]

Space is a pure intuition. On the division of space, Kant says, "Space is essentially one, and multiplicity in it, consequently the general notion of spaces, of this or that space, depends solely upon limitations."[146] The division of space "depends solely upon limitations" (*überhaupt beruht lediglich auf Einschränkungen*).[147] *Einschränkungen* can be translated as "qualification or modification of conditions."[148] By this, Kant implies that spatial divisibility is not real but abstract because limitation is a qualification of the mind *a priori*. If space depends on a mental phenomenon, it cannot be

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[145]Kant, 23-24.

[146]Ibid., 24.

[147]Kant, Kritik der Reinen Vernunft, 52.

[148]Trevor Jones, The Oxford-Harrap Standard German-English Dictionary, vol. 1 (Oxford: Clarendon, 1977),

absolute. However, Torrance criticizes the Kantian philosophy of space and time as transferring the point of absolute rest to the center of human consciousness. Theologically it means that "there can be no God for man outside of himself or independent of his consciousness."[149] Torrance's concern is Christological. He worries that the Kantian theory of space and time will lead to a reconstruction of the Incarnation in accordance with "a false ontology built out of mechanistic concepts or in a pietistic existentialism in accordance with man's religious self-expression."[150] Although Kant's synthetic *a priori* knowledge depends on possible experience, his thesis does not necessarily lead to either solipsism or existentialism. We commonly believe that our private sensory experiences share a common objectivity. In the philosophy of mind, the objectivity of sense experience has been debated through the concept of "inverted qualia." Physicalists commonly object to the qualia arguments.[151] Nevertheless the objectivity of sense experience is intuitively clear, Thomas Nagel wrote,

> There is a sense in which phenomenological facts are perfectly objective: one person can know or say of another what the quality of the other's experience is. They are subjective, however, in the sense that

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[149]Torrance, Space, Time and Incarnation, 44.

[150]Ibid.

[151]Daniel C. Dennet, Consciousness Explained (Boston: Little, Brown and Company, 1991), 369-411.

> even this objective ascription of experience is possible only for someone sufficiently similar to the object of ascription to be able to adopt his point of view—to understand the ascription in the first person as well as in the third, so to speak. The more different from oneself the other experience is, the less success one can expect within this enterprise.[152]

For instance, when I see a red rose, I have a red sensation in my mind. Not only that, I furthermore assume that someone else who is seeing that same red rose also has that same red sensation in her mind. This objectivity of private sensation makes it possible for the two of us to converse meaningfully on the red rose. The objectivity of sensory experiences must be grounded on the mind God, and not on the objects of this world, because we want to allow the plausibility of communicating private experiences outside the realm of the physical universe. In summary, I do not think that Kant's transcendental aesthetics is incompatible with Torrance's Christological theory of spacetime. Hence Torrance's objection to Kant's theory is unnecessary and unsupported.

Another argument against spatial absoluteness is based on special relativity. If space were absolute, the distance ΔL between two spatial locations should remain invariant, independent of any reference frame. The spatial absoluteness hypothesis is dethroned by Einstein's special theory of

[152]Thomas Nagel, "What Is It Like to Be a Bat?" The Nature of Mind, edited by David M. Rosenthal (New York: Oxford, 1991), 424-425.

relativity which says that space contracts when viewed by a moving observer. Space contraction is verified by the null result in the Michelson-Morley experiment.[153]

Advocates of absolute space may object that space contraction is only an optical illusion. The common sensical concept of space is a void in which bodily objects have their movements. Bodily objects have extensions and separations. One may argue that there needs to be a "place" to hold these bodies. Space as a receptacle of mass is rejected by Torrance on theological grounds, he says,

> This receptacle concept of space was rejected by Patristic theology, but when it entered into Western thought with Aristotelian physics and philosophy under the category of magnitude, apart from the concept of time, it tended to encourage a *deus sive natura* view of the relation between God and the world but at the same time led to their separation in a sharp distinction between nature and supernature and consequently to a corresponding distinction between natural theology and revealed theology.[154]

Beside the theological considerations, there are also metaphysical objections to the receptacle theory of space. The concept of space as a receptacle has its hold in common understanding. Before we become too accustomed to the convenience of common notions, let us rejoin a Gedanke experiment to

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[153]Richard Feynman, Lectures on Physics, vol. 1 (Reading, MA: Addison-Wesley, 1963), 15–3-15–5.

[154]Torrance, 56-57.

reveal the fallacy of the receptacle theory. First, let us imagine a possible world in which there is nothing. We ask ourselves the question, "Does absolute space exist in this possible world?" If the answer is affirmative, then I suppose that I can pick out a location L_1 and distinguish it from another location L_2. I can also suppose that I can judge the distance between L_1 and L_2 as such and such apart. Since this empty world is not furnished with any measuring rod, there is no meaningful way to measure its length. If I were to mentally point at the locations L_1 and L_2 and devise an abstract metric to give meaning to their separation, then space owes its form to my mental conjugation. Secondly, an empty universe is nothingness. To say "nothingness exists" is to violate the law of non-contradiction. Hence we see that the concept of space devoid of matter is problematic. Next, we introduce a point-like particle into this otherwise empty universe. We ask the question, "Is the particle here or there?" The answer is an emphatic no. The argument is the same as before because there is no real way to assign meaning to the concepts of "here" and "there" in an otherwise void aside from the particle. In this case, absolute space is tautological. At last, we introduce a second particle into this universe. Now the concept of extension is meaningful because the particles cannot occupy the same space. Their

separation also becomes meaningful because it is now learned that it takes time for one particle to have an effect on another since distance is equal to time divided by the speed of light. The introduction of time to the concept of space implies that the concept of time is prior to the concept of space. As we can see, both time and space logically and ontologically depends on matter and *a priori* experience. Since space and time are not matter, space and time are pure intuition *reductio ad absurdum*, which is just an alternative way to deduce Kant's conclusion.

Relativity treats the three dimensions of space and the dimension of time collectively as the four dimensions of the spacetime. The distinction between space and time is blurred in relativistic kinematics. Nobel physicist Richard Feynman sees the interchangeability of space and time as a real truth about Nature, not merely a mathematical contrivance.[155] In fact, I would say that most physicists today concur with Feynman on the interchangeability of space and time.[156] Despite the apparent differences,

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[155]Feynman, 17–1-17–2.

[156]J. R. Lucas and P. E. Hodgson, Spacetime and Electromagnetism (Oxford: Clarendon, 1990), 15-16. The most mathematically elegant way to demonstrate the interchangeability of space and time is to the compare the form of the Cartesian rotation matrix

$$\begin{pmatrix} \cos\theta & \sin\theta \\ -\sin\theta & \cos\theta \end{pmatrix}$$

and the Lorentz transformation matrix

$$\begin{pmatrix} \cosh\phi & i\sinh\phi \\ -i\sinh\phi & \cosh\phi \end{pmatrix}$$

space and time have many identical qualities. They are both pure intuitions according to Kant and are mutually dependent in that a time measurement cannot be made outside of space, and vice versa. The concept of spacetime can be extended beyond the physical universe to more intangible territories such as the mind of God. The discussion on spacetime in the Godhead will be treated in more details the chapter 4.

The Concept of Mass

"Mass" and "matter" are often used interchangeably. The etymology of the word "mass" has an unusually religious root. The Vulgate has *massa caricarum, massa ficorum* and *massa palatharum*. *Massa* is translated as "dough" or "paste." The Greek *maza* (μᾶζα) means "barley cake." The Hebrew *mazza* (מצה) is the unleavened bread of the Israelites. Max Jammer discovers that the concept of mass originated from a logical analysis concerning the Eucharistic transubstantiation of the Holy Bread.[157]

In Aristotelian physics, matter is the capacity to receive form and to be formed, where a form is that which is in matter and makes (or forms) it

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where $\beta = \frac{v}{c}$, $\gamma = \left(1-\beta^2\right)^{-\frac{1}{2}}$, $\tanh\phi = \beta$ and $c = 1$.

[157]Max Jammer, Concepts of Mass (Cambridge, MA: Harvard, 1961), 7-15.

into the object it is.[158] To Aristotle, matter is that permanence present in anything that changes.[159] *Quantitas materiae*, the notion of "how much" of matter, was still foreign to Aristotle. Neoplatonists, such as Plotinus, distinguished between matter and body (corporeality). Body is a composite of which matter is an element. As incorporeal existence, matter is only "an image and phantom of extension."[160] During the medieval period, the concepts of mass and matter are of great import to the theological topics of creation, death and transubstantiation.[161] Shortly after, Kepler developed the concept of inertial mass, where inertia is a resistance to change. Newton identified masses as physical bodies. Physical bodies are systematized by the three laws of motion in terms of the concepts of force and inertia in his Principia.[162] Leibniz distinguished between primary matter (*materia prima*) which is an impenetrable matter, and secondary matter which is a plurality of substances. Kant rejected Newton's concept of *vis inertiae*, the innate force of matter expressed as the reaction force in the third law of motion which states that for every force acting on a body there is an equal and

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[158]Peter A. Angeles, Dictionary of Philosophy (New York: Harper, 1981), 103.

[159]Ibid., 163.

[160]Jammer, 31.

[161]Ibid., 40-41.

[162]Ibid., 64-65.

opposite inertial force resisting it. Although Kant's presentation of his ideas was obscure, he was aware of the problems of Newton's concept of mass. Kant's rejection of *vis inertiae* prepared the way for a more positivistic approach to the concept of mass.[163] In modern times, mass is defined as an abstract ratio of force over acceleration after Newton's second law, i.e. $m = F/a$.[164] Feynman equates mass as a quantitative measure of inertia.[165] The understanding of mass has undergone a radical recalibration when Einstein formulated the mass-energy equivalence principle, commonly known as $E = mc^2$. Not only can mass be now thought of in terms of energy, more astonishingly, mass also "grows" in much the same way as time dilates in special relativity.

In lieu of the complexity associated with mass and its equivalents, we must bear in mind matter's simple fundamental properties. Physicist Max Born offers a succinct definition of mass as "the amount of some material."[166] Mass is a substance having independent subsistence apart from others. One common notion of a property of mass is that it is either here or

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[163]Ibid., 83-84.

[164]Ibid., 101.

[165]Feynman, 9·1.

[166]Weaver, 60.

there. Space as I have argued before is a mental property. In this case, the spatial property of mass is immediately problematic. In order to solve this problem, I will invoke another violation of common sense. I will make the audacious claim that mass has no multiplicity—meaning that there is no multiplicity of bodies as we so common sensically believe. There is only one mass in the universe, but different stratifications and equivalents thereof. There is no need for "space" between bodies because there are no boundaries in a singular mass. The gradients of the material "density" define the abstract "boundaries" between the strata of mass commonly referred to as "bodies." Mass may have many equivalents, one being energy according to Einstein's equivalence principle. My view is supported by an analogy from modern physics. According to quantum mechanics, a particle can be thought of as a statistical fluid with no real definite boundary. Its existence is described by a wavefunction. Now imagine two particles whose existence are derived from one single statistical fluid. Their wavefunctions overlap and their distinctions are differential sameness. I can conceive of the whole universe as a collection of overlapping wavefunctions, a differentiated statistical soup. The distinctiveness of the particles can be further obscured by combining all the separate wavefunctions into one canonical wavefunction of the universe. Steven Hawking is one of the proponents of

the existence of such a cosmic wavefunction. The purpose of conceptualizing mass as a differentiated whole is to remove the common sensical notion of space as a receptacle of mass.

Conclusion

In this section, I have tried to show that spacetime, unlike mass, is not a real thing but a mental property. Two out the three fundamental units of the physical world, namely space and time, subsist in sense experiences. It leads to the conclusion that physical science is both a psychological and physical discipline. It is psychological in the sense that its object necessarily involves consciousness. We can conceive of a possible world in which God created a universe devoid of human beings. In fact, humans were the last to be brought into creation according to the Genesis account. Hence the universe was operational before the consciousness of men began to play a part. In other words, the physical world does not need our sense experience to give it its frame of movements. Since sense impressions are necessary for the motions of the universe and we are not the ones ultimately providing the required senses, the only logical conclusion is that God is the one who defines spacetime in the universe through His impressions. This deduction leads me to the most important conclusion of this chapter, that is, the

integration of science and theology is a necessary condition in the search of ultimate knowledge.

Integration means more than just a peaceful coexistence of science and theology. The nature of God must have a profound influence on the structure of physical laws. The most fundamental attribute of God is His Trinitarian nature. Karl Barth begins his Church Dogmatics with the doctrine of the Trinity because he believes that theology is founded on the understanding of the triune nature of God. Like theology, science must also pattern its theories after a solid Trinitarian theology in order to capture the true character behind the various *personae* of creation.

CHAPTER 4

UNDERSTANDING THE TRINITY

Good science is structured after reality. There are only two categories of existence, those which exist eternally and those which exist contingently. Eternal objects belong to the category of the divine and contingent objects to that of the created. All eternal qualities reside in the Godhead. Contingent objects are created by God to reveal the Godhead. The Apostle Paul says, "For since the creation of the world His invisible attributes (αίδιος), His eternal power (δύναμις) and divine nature (θειότης), have been seen, being understood through what has been made, so that they are without excuse" (Rom. 1:20, NASV). Created objects cannot be Trinitarian *per se* but are mere representations of the Trinity. Reality, grounded on either God or the λόγος of God, is Trinitarian by association since God is Trinitarian. A solid understanding of the Trinity is the foundation for the metaphysics of physical theories. The Trinity is a non-trivial concept. It qualifies as the ultimate intellectual challenge both in philosophy and theologio-science. Many ideas have been accepted into the

canon of orthodoxy, which are philosophical interpretations of biblical concepts. The concept of the Trinity, though rooted in an exegesis of Scripture, is strongly philosophical throughout its development. History is an indispensable tool for theological studies. According to J. P. Moreland, good arguments do not go out of date. A historical study of the doctrine of the Trinity is in many ways the same as the theological study itself. In this chapter, I will begin with a survey of the cumulative scholarship on Trinitarianism. Then, I will exposit some new insights of the orthodox view of the Trinity toward the end.

A History of the Trinity

The doctrine of the Trinity spanned a history of two thousand years. The matriculation of the doctrine is the product of a complex interplay between personalities, politics, cultures and theology. The following is an outline of some important developments in the history of thought.

The Origin of the Doctrine

There is no clear understanding on the origin of the doctrine of the Trinity due to the scanty and enigmatic nature of the first century Christian documents. Some scholars believe that the concept of the Trinity does not

predate the New Testament period, while others claim that the Old Testament does allude to the Trinity. One source of controversy concerns the plural form of the second most frequently used Hebrew word for God אֱלֹהִים. Technically, the word could be translated as "gods" or "god and angels." The plural form of אֱלֹהִים is commonly understood as a plurality of majesty.[167] For example, Louis Berkhof says, "The plural is to be regarded as intensive, and therefore serves to indicate a fullness of power."[168] Gordon Wenham explains,

> As here, Hebrew generally prefers the plural form of the noun, which except when it means "gods," i.e., heathen deities, is construed with a singular verb. Though the plural has often been taken to be a plural of majesty or power, it is doubtful whether this is relevant to the interpretation of אלהים. It is simply the ordinary word for God: plural in form but singular in meaning.[169]

The second source of controversy is the use of the plural form of personal pronouns in Genesis 1:26 in which God said, "Let *us* make man in *our* image." John Skinner rejects the interpretation that God is conferring among the persons within the Godhead more than announcing His crowning work to the members of the heavenly court (Gen. 3:22, 11:7; Isa. 6:8; 1 Kgs.

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[167]R. G. Crawford, "Is the Doctrine of the Trinity Scriptural?" Scottish Journal of Theology, vol. 20, no. 3 (1967), 282.

[168]Louis Berkhof, Systematic Theology (Grand Rapids: Eerdmans, 1941), 48.

[169]Gordon J. Wenham, Word Biblical Commentary, vol. 1 (Waco, TX: Word Books, 1987), 14.

22:19-23; Job 15:8; Jer. 23:18).[170] Victor Hamilton speculates that Moses cannot be a "Trinitarian monotheist."[171] Christopher Stead claims that the only possible hint to the Trinity in the Old testament is the image in which the Lord God sits enthroned, attended by two angels, one on the right hand and the other on the left.[172] The angels can either be the two Seraphim of Isaiah's vision, or the two Cherubim who mount guard over the Ark. Some Jewish scholars identify the angels to be Gabriel and Michael. Stead thinks that Philo associated the role of the Logos with Michael and that St. Luke might have treated Gabriel as the representative of the Holy Spirit.[173] The image of the two angels and God as pointed out by Stead can be at best a subliminal association to the concept of the Trinity, but not as a "hint" as it is suggested. The New Testament is clear that angels are categorically different from God. The author of the book of Hebrews says that Christ is more superior than angels (Heb. 1:1-14). It is doubtful that God would have chosen an imagery for the Trinity to be placed in the Old Testament that directly contradicts the New Testament's Christological teaching.

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[170]John Skinner, Genesis: The International Critical Commentary, 2d ed. (Edinburgh: T. & T. Clark, 1980), 30-31.

[171]Victor P. Hamilton, The New International Commentary on the Old Testament: The Book of Genesis, Chapters 1-17 (Grand Rapids: Eerdmans, 1990), 132.

[172]George Christopher Stead, "Origin of the Doctrine of the Trinity 1," Theology, vol. 77 (October 1974), 514-515.

There are other attempts to find Old Testament support of the plurality of the Godhead. For example, Robert Jenson relates the salvic history of Israel in the Old Testament as the "root" of his Trinitarian logic. According to Jenson, God "is" Jesus; the Spirit is the power of the future to overturn and to fulfill the present while the Father is Jesus' address to the transcendence of His life and work.[174] Another example of seeking an Old Testament root of the Trinity is the emphasis of the distinction of referents of Old Testament words such as "word", "wisdom", "spirit" and "the Messiah." Even though these words are sometimes used to refer to personified entities in the Old Testament, they do not qualify as representations of the divine Persons. The Word of Yahweh is the way by which He reveals His will to men. The Word is not identical to Yahweh Himself. Wisdom is seen by scholars as God's activity, or an attribute of God, but not as the person of God. Although the character of the spirit of Yahweh in the Old Testament is manifestly in affinity with that of the Holy Spirit in the New Testament, the Old Testament writers generally regard the Spirit as a mere impersonal divine force. Wilf Hildebrandt wrote,

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[173]Ibid.

[174]Carl E. Braaten and Robert W. Jenson, Christian Dogmatics, vol. 1 (Philadelphia: Fortress, 1984), 99-105.

> References to the *rûah* in relation to God in the Hebrew conception are understood as the extension of God's personality through which the divine plans as effected. Thus, Hebrew thought usually associated the *rûah* with power, ability, creativity, and saw it as an extension of the presence of God. The *rûah* was understood descriptively to indicate God's activity and presence in some way. It may be going too far to state that the OT presents an ontological understanding of the *rûah* as a person.[175]

Therefore the interpretation of "spirit" as a Person of the Trinity in the Old Testament is highly speculative. The same is true of the word "Messiah." Although there was a mood of Messianic expectation in the Old Testament, the word מָשִׁיחַ is used only twice in Daniel 9:25-26, which is rendered either "the anointed one" or "the Messiah Prince."[176] The primary sense of the title is "king," as the anointed man of God, but it also suggests election.[177] In the early stages of Israel, the Messiah is sought only as a visible powerful ruler. Later Judaism points to a Messiah not only as a human king but as an eschatological king.[178] One way or the other, it is very unlikely that מָשִׁיחַ is referred to as the second Person of the Trinity in the minds of the Israelites. In fact, many church historians believe that the idea

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[175]Wilf Hildebrandt, An Old Testament Theology of the Spirit of God (Peabody, MA: Hendrickson, 1995), 89.

[176]Francis Brown, S. R. Driver, and Charles A. Briggs, A Hebrew and English Lexicon of the Old Testament (Oxford: Clarendon, 1972), 603.

[177]Walter Elwell, Evangelical Dictionary of Theology (Grand Rapids: Baker, 1990), 710.

[178]Ibid.

of the Trinity was non-existent in the minds of the Old Testament writers. Edmund J. Fortman wrote,

> Thus the Old Testament writings about God neither express nor imply any idea of or belief in a plurality or trinity of persons within the one Godhead. Even to see in them suggestions or foreshadowings or "veiled signs" of the trinity of persons, is to go beyond the words and intent of the sacred writers.[179]

Other commentators are more cautious about completely ruling out the Old Testament as a viable source of biblical support of Trinitarianism. Hamilton says,

> True, the [Trinitarian] concept may not be etched on every page of [the Old Testament] Scripture, but hints and clues are dropped enticingly here and there, and such hints await their full understanding "at the correct time" (Gal. 4:4).[180]

Monotheism is a strong motif among the writings of the prophets. The nation of Israel was commissioned by Yahweh to be a holy testimony of the one and only true God. Ironically, the Israelites were constantly proselytized by pagan religions which were often polytheistic in nature. Given the evil influences encompassing the nation of Israel, any hint of the triadic nature of God in the Old Testament would have probably been misunderstood as polytheism by the Israelites. It is not unreasonable to assume that God in His infinite wisdom would not have chosen to reveal the secret of Triunity at

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[179]Edmund J. Fortman, The Triune God (Grand Rapids: Baker, 1972), 9.

that time and risked a potential stumbling block to His chosen people. Wilf Hildebrandt concurs with J. B. Payne "that OT emphasizes the unity of God and avoids the revelation of trinitarianism to guard against polytheism may be valid."[181] It is also reasonable to say that the prophets who spent much of their time engaging in apologetics against polytheistic influences would not naturally suspect a plurality of persons in the only true God. Nevertheless the place of the Trinity in the Old Testament cannot be easily decided. Armed with a highly speculative apparatus called prosopological exegesis, church fathers such as Justin, Tertullian and Athanasius claimed that the Old Testament testified to the doctrine the Trinity. From several passages in Psalms and Isaiah, Tertullian argued,

> So in these [texts], few though they be, yet the distinctiveness of the Trinity is clearly expounded: for there is the Spirit himself who makes the statement, the Father to whom he makes it, and the Son of whom he makes it. So also the rest, which are statements made sometimes by the Father concerning the Son or to the Son, sometimes by the Son concerning the Father or to the Father, sometimes by the Spirit, establish each several Person as being himself and none other.[182]

Despite the interpretative possibility offered by prosopological exegesis, the Old Testament only implicitly supports the doctrine of the Trinity at best.

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[180]Hamilton, 134.

[181]Hildebrandt, 88-89.

[182]Cited in Michael Slussen, "The Exegetical Roots of Trinitarian Theology," Theological Studies, vol. 49 (September 1988), 465.

However silence does not imply opposition. Benjamin Warfield, while reluctant to admit a broad Old Testament support of the Trinity *per se,* advocates for a continuity of the revealed doctrine of the Trinity between the Old and the New Testaments.[183] The Old Testament contains many important doctrinal elements, including the doctrine of the Trinity, which were passed down as oracles and remained as mysteries until the time of the New Testament revelation. It is to say that the Old Testament supports of the Trinity, though not all together absent, most certainly went undetected among its contemporary audience. Given the occasions to defend the deity of Christ, the New Testament provides the apologetic context in which the Trinitarian language was first loudly spoken.

Many New Testament passages support the divinity of the Father, the Son and the Holy Spirit (John 1:1 and Acts 5:3-4). The New Testament is permeated with icons of the Trinity. The most obvious examples are the Gospel of John and the book of Hebrews which explicitly defend the deity of Christ. Why did the Trinity suddenly become prevalent in the New Testament? This question leads some scholars to think that the notion of the Trinity is of Hellenistic import.[184] To answer the question, it is helpful to

[183]Benjamin Breckinridge Warfield, Biblical and Theological Studies (Philadelphia: The Presbyterian and Reformed Publishing Company, 1952), 22-59.

[184]George Christopher Stead, "The Origins of the doctrine of the Trinity 2," Theology, vol. 77

know a few basic facts about the ancient Greek culture. First of all, it is highly interpretative as to whether Greek philosophy near the Christian era was more dualistic or triadic in orientation. Some understood Greek philosophers to teach axiological dualism which emphasized that the body and soul were the two opposing principles of the world. John W. Cooper wrote,

> The Orphic cults, the Gnostics, and Platonic philosophers all embraced a worldview in which matter and spirit or material and the ideal are in metaphysical antipathy to each other.[185]

Christopher Stead on the other hand sees a trend of triadic theology in Platonic philosophy, especially in Plato's Timaeus. He wrote,

> It looks as if the Father-Mother-Child image of *Timaeus* 50 d has been interpreted in two different ways, one of which yields a *Familientrias* of God, his consort Wisdom and the divine Logos, his Son and world-ruler, who as son must imitate the invisible and rational nature which belongs to the Father.
> The *Familientrias*, we have noted, is rather sparsely represented in early Christian documents which treat the Spirit as feminine; but it deserves notice, particularly because a striking new example has appeared in a recently published document, the *Tractatus Tripartitus* from Nag-Hammadi. This describes the eternal unbegotten Father, his first-born and only Son (who in some sense identical with him, as his own self-knowledge and self-utterance), and thirdly Ecclesia, who again does not infringe the Son's uniqueness. But Ecclesia seems to have a double character; she represents the love—indeed the kiss—that unites Father and Son, in a manner that recalls Augustine's doctrine of the Spirit; but she is also the pre-existent Church consisting of “holy

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(November 1974), 582-589.

[185]John W. Cooper, Body, Soul, and Life Everlasting (Grand Rapids: Eerdmans, 1989), 202.

> imperishable spirits". We must not stay to explore this concept; but it is worth remembering that some relics of the primitive doctrine of the Spirit as the consort or daughter of the divine Father are still effective in our image of the Church as the holy and predestined Bride of Christ.[186]

The triadic Greek theology was based originally on three independent principles such as God, matter and Ideas and later as God, matter and demiurge.[187] Triadic principles differed from the Trinity in that the former is not required to be essentially one. The doctrine of the Trinity states that the three divine Persons are one in nature—a mystery with which the triadic principles are not burdened. Hence the concept of the Trinity is essentially different from the Greek triadic counterpart. There are also triadic traditions in ancient cultures other than the Greek. But none bear the same quality as that of the concept of the Trinity. George Hoynacki, after surveying all of the triadic complexes among different world religions, concluded that the Trinity is a uniquely Christian concept,

> The Trinitarian dogma, on the other hand, is not derived from any triadic philosophies. No triad has ever developed into a Trinity. The invocation of the Father, of the Son, and of the Holy Spirit, represents trinitarianism to a supernatural level, a divine mystery, not a philosophy. Thus, at the very threshold of Christianity, we find that the invocation of the divine name, under the triune designation of the Father, Son, and Holy Spirit, is something entirely new in the religious experience of mankind. In none of the pre-Christian or non-Christian

[186]Stead, 588.

[187]Ibid., 583-584.

> religion is there the remotest hint of a triune nature of God. The triads are basically artificial contrivances, while the Trinity represents three consubstantial Persons, a sublime mystery which separates the trinitarian invocations to God from all preceding triads. It gives the one transcending element to the whole of Christian ritual. It moves in a supernatural plane.[188]

Barth also thought that the Trinity is solely a consequence of the divine revelation,

> The statement, "God reveals Himself as the Lord," understood in this sense, i.e. the meaning intended by this statement, and therefore the revelation itself attested by Scripture we call "the root of the doctrine of the Trinity."[189]

The doctrine of the Trinity is never directly taught in the Old or New Testament. It is the abundance of exegetical evidence that leads to the inception of the doctrine.

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[188]George J. Hoynacki, "Triadic Complexes and Trinities in Religious Traditions," Asia Journal of Theology, vol. 4 (April 1990), 261.

[189]Karl Barth, Church Dogmatics, vol. 1, pt. 1 (Edinburgh: T. & T. Clark, 1969), 353.

The Patristic Period

The apostolic fathers believed in one God who is the Creator, Judge, Father of the universe and the Son. All, except Hermas, subscribed to the divinity of Christ. The Holy Spirit was not considered God. Yet most of the apostolic fathers favored His distinct personality, with the exception of Hermas and possibly 2 Clement.

The Apologists had a two-stage theory composed of an immanent and an uttered Logos: "God, then, having His own Word internal (λογον ενδιαθετον) within His own bowels begot Him, emitting Him along with wisdom before all things … He begot the Logos, uttered (προφορικος), the first born of all creation."[190] The Apologists contributed little to pneumatology. Although there were many more clear-cut Trinitarian passages in the Apologists than the Apostolic Fathers, many questions about the deeper unity of the three distinct divine Persons were left unanswered. Their best explanation of the Triunity of the Godhead was: a unity of power, a unity of rule.

Origen maintained the eternal generation of the Son. He abandoned the two-stage theory of the pre-existent Logos and substituted for it a single stage theory in which the Son is presented as an immanent intellectual

[190]Fortman, 49.

procession from the Father. Origen was the first theologian to use the terms "homoousia" (ὁμοούσια) and "hypostasis" (ὑπόστασις). Homoousia means "substance." In this sense, Christ is said to be *homoousios* with the Father. The Greek term hypostasis refers to "a real personal subsistence or person." Origen is also the first to speak of the Trinity as one ousia, three hypostases (μία οὐσία τρεῖς ὑπόστασεις). The word οὐσια expresses primarily real existence, actual being—that which actually is. As used by Plato it is the special characteristic of the Ideas—the realities (τὰ ὄντα) as contrasted with the appearances on earth (τὰ φαινόμενα). The word ὑπόστασις is generally regarded as a possible equivalent of οὐσία expressing the essential *substratum*. As a philosophical term, ὑπόστασις is a much more rare word compared to οὐσία. But οὐσία and ὑπόστασις remain in use side by side. Origen is the first to attempt to discriminate between them. But it was not until Nicea when theologians drew a real distinction between the two by using οὐσία to express the existence or essence or substantial entity of the Trinity as God, and ὑπόστασις to express the existence in a particular mode, the manner of being of each of the Persons. The Greek usage of "person" πρόσωπον at this time was very different that what it is today. Person always designates status, or character,

or part, or function. Not that it is separate from some living subject or agent, but the attention is fixed on the character or function rather than on the subject or agent.[191]

The doctrine of the Trinity during the pre-Nicene phase was impeded by a general sense of vagueness and ambiguity. Arius saw two conflicting ideas—one that the Son is God, the other that the Son is subordinate and inferior to the Father in divinity. He resolved the tension between the two ideas by claiming that the Father alone is God in the strict sense and that the Son is a "diminished god" but not a creature. To him, Trinitarianism is inadequate to describe the nature of God. He boldly asserts that the Son is not God, He is a perfect creature, not eternal but created by the Father *ex nihilo*.

In 325, the Council of Nicea firmly declares that the Son is begotten, not made, is born of the Father's substance, is true God from true God, is consubstantial with the Father (ὑποούσιος τῷ πατρί). Arians read into the biblical affirmations of the Son their own anti-Trinitarian meanings. To counteract this Arian abuse of the Scripture, Nicea interpreted the biblical affirmations into ontological formulas. It gathered all of the Scriptural

[191]J. F. Bethune-Baker, An Introduction to the Early History of Christian Doctrine (London: Methuen, 1958), 231-238.

affirmations and symbols about the Son into a single expression of ὑποούσιος τῷ πατρί. Nicea defines what the Son is in Himself and in relation to the Father, "He is all that the Father is, except for the name of Father."[192] The formulation of the ontological status of the Son marks the historical and dogmatic importance of Nicea.

After the Nicene Council, Athanasius became the great defender of the Nicene Creed against the Arians. He maintains a strict consubstantiality of the Son and Holy Spirit with the Father. But he thinks that the inner nature of the Trinity is somehow beyond reason. Athanasius has no term or definition for Persons and indeed no formula to express God's Triunity. It was the Cappadocians who made the most important contribution to the Greek Trinitarian doctrine. They choose "hypostasis" as the word best fit to express person. Their formula for the Triunity of God was "one ousia in three hypostases." They make the Trinity of hypostases their methodological starting point and affirm the full deity of the Holy Spirit whom they explicitly call God. This step effectively puts an end to subordinationism. The Cappadocians differentiate the three hypostases metaphysically in terms of cause, relation and modes of existence. They try to differentiate the Holy Spirit's origination from the Father through the Son

[192]Fortman, 96.

as breath from the Son's generation from the Father. They try to answer the question of God's Triunity in terms of "relations of caused and cause," "modes of being and being" that account for the distinction of hypostases without multiplying ousia.

The personality of the Holy Spirit was addressed for the first time before a synod at Alexandria in 362, on the return of Athanasius from his third exile. All present agreed in the faith in

> a Holy Trinity, not a Trinity in name only, but really existing and subsisting, both a Father really existing and subsisting, and a Son really and essentially existing and subsisting, and a Holy Spirit subsisting and himself existing: a Holy Trinity, but one Godhead, and one beginning (or principle); and the Son is co-essential with the Father, as the fathers said; while the Holy Spirit is not a creature, nor foreign, but proper to, and inseparable from, the essence of the Father and the Son. … For we believe that there is one Godhead, and that its nature is one, and not that there is one nature of the Father, to which that of the Son and of the Holy Spirit are foreign.[193]

The Alexandrian Creed was expanded and later expressed succinctly in the Epiphanian Creed published in 374. The Creed declares in simple untechnical language the divine personality, the eternity and the divinity of the Holy Spirit. (1) The Holy Spirit is co-ordinated with the Father and the Son. He too is κύριον as the Son, and He proceeds ἐκ τῆς οὐσίας τοῦ πατρός (out of the Father's essence). (2) Eternity is implied in the phrases

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[193]Bethune-Baker, 213-214.

which show personality, particularly by ἐκπορευόμενον (going forth), which connotes neither beginning nor end; also to some extent, by the title ζωοτοίον. (3) The Spirit is placed on the same level as the Father and the Son, and is worshipped as only one who as God can be, along with the Father and the Son. (4) The Holy Spirit is the source of all real life, the source of inspiration of the prophets, the agent in the Incarnation of the Son and the source of graces which the Church administers. (5) The relation between the Spirit and the Godhead is simply described in the words ἐκ τοῦ πατρός (out of the Father). Compared to the Nicene Creed which is intended to deal with Christology only, the Epiphanian Creed is designed to defend the Person of the Holy Spirit.[194] In 381, the emperor Theodosius convoked the Second Ecumenical Council at Constantinople. They define the divinity of the Holy Spirit without explicitly calling Him God or ὁμοούσιας τῷ πατρί (of the same essence as the Father).

Photius, known as the greatest scholar of his day, led the opposition to the Filioque innovation in the West. The term "Filioque" means "from the Son." It refers to the Western version of the Nicene Creed which says that the Holy Spirit proceeds from the Father and the Son. Originally it is not in

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[194]Ibid., 214-217.

the confessions agreed to at Nicea and Constantinople. It seems to have been first inserted at the Council of Toledo in 589. Filioque formed the main doctrinal issue in the rupture between East and West in 1054. Photius' basic argument against Filioque was found in Mystagogia Spiritus Sancti which states that the Son is born of the Father alone and so the Holy Spirit proceeds from the Father alone. The Filioque controversy has provoked endless theological literature out of proportion to its importance, which continues even today.

Tertullian in his Against Praxeas vigorously refutes the Monarchianism of Praxeas. There are two main strands of Monarchianism, dynamic and modalistic. Praxeas' unitarianism belongs to the second category. Modalistic Monarchianism, also known as modalism, attempts to reconcile the deity of Christ and monotheism by identifying the Son with the Father. This leads to patripassianism which teaches that it is the Father who incarnated, was born of a virgin and died on the cross. Against Praxeas' modalism, Tertullian sets out what he calls the "Rule of the Faith" in which the historical, soteriological and ontological position of Christ is affirmed. Tertullian accepts the two stage theory of the Logos and thus rejects the eternal generation of the Son. He is the first in the West to use the word *trinitatis* and indicated clearly that the Trinity of one divinity is not merely

an economic Trinity, but an immanent Trinity. He is also one of the first to use the word *personae* for the three. Tertullian understands a person to be a concrete individual or a self. Many of his teachings later appear in the Symbol of Nicea.

Ambrose of Milan treats the person before nature. His theology is on the side of strict consubstantial Trinity. He strongly opposes Arianism and Macedonianism and is the first in the West to write authoritatively on the Holy Spirit.

Augustine's passion and insights are captured in his magnificent De Trinitate. Instead of starting with the Father as the source of the other two Persons, he begins with the one simple divine essence that is the Trinity. This approach secures the equality of the three for they have the same essence, will and operation. Augustine does not like the term "person" but he accepts it and uses it quite extensively. For him, the three are three "something," three "someone," or to use later terminology "three subjects of one divine activity who were only relationally distinct," or more simply "three relationally distinct subsistents in one intellectually divine nature." Augustine teaches the Holy Spirit as Gift and Love and Inhabitant of the just soul. He maintains that the Holy Spirit proceeds from the Father and the Son, though principally from the Father. The Father and the Son are not two

principles but one principle of the Holy Spirit, as they are one Creator and one Lord. Augustine's greatest originality is manifested in his search for analogies of the triune God in the world. His best analogies are found in the mind of man whom God creates in His image and likeness: (1) that of lover, beloved and their love; (2) that of remembering, understanding and loving God. His second analogy lays the foundation for psychological theory of divine processions by Thomas Aquinas. Augustine sums up the work of his predecessors and sets the stage for most all subsequent Trinitarian theology in the West.

Boethius is second only to Augustine in terms of scholarship. He is the first to apply Aristotelian methods to theological problems and to the elucidation of dogmatic statements. To answer the problem of three in one, Boethius argues that in their divine substance there is an absence of difference and an absence of otherness. The principle of plurality is otherness. Plurality is unintelligible apart from otherness. Where there is no difference, there is no plurality and hence no number, but only unity. To address the question of number in the Trinity, he turns to the Aristotelian categories—ten categories predicated of things, such as substance, quality, quantity, relation and so on. But he quickly qualifies this method by saying that these categories change their meaning when applied to God. God is a

supersubstantial substance. For instance, the proposition "God is just" mentions a quality which is not accidental but rather supersubstantial. Substantial predication is pertinent to God, but accidental predication is not. Since the diversity of Persons makes the Trinity, the Trinity does not pertain to the substance. Hence neither the Father, the Son, the Holy Spirit nor the Trinity can be substantially predicated of God, but only relatively. In pondering relative predication, he concludes that relative predication could not increase, decrease or change anything in reality of which it is predicated. Boethius' relative predication does not guarantee a solution. Relation presupposes difference. "<u>A</u> is relative to <u>B</u>" implies <u>A</u> is not the same as <u>B</u>. To say that Persons differ in relation is to admit that there is a difference among these Persons. In this case, the question of number is still unanswered. Boethius declares that the only otherness is that of Persons. But he also says that in God this otherness of Persons is hardly intelligible. He defines the concept of person as "an individual substance of a rational nature." Boethius equates Greek terms π˘στασὶ and πρ˘σωπον with person, and ο⋋σα with essence. This definition of person later becomes famous, widely adopted, highly praised and strongly criticized all at the same time. How can a person be a substance while the Persons of God are restricted to the category of relative, but not substantial, predication?

Besides, the three Persons are three individual substances of a rational nature, whereas in God there is only one substance. Although Boethius' definition of person leaves something to be desired, it nevertheless indicates three important notes that constitute a person—substantiality, intellectuality and incommunicability.

The Medieval Period

Anselm of Canterbury (d. 1109) has been called the first original thinker in the West since John the Scot. Theologically, he is in direct descent from Augustine. To the question, how can unity and plurality be reconciled, he answers in the famous phrase (Denz 1330), "Unity does not lose its consequence unless some opposition of relation stands in the way (*ubi non obviat aliqua relationis oppositio*)."[195] In other words, everything in God is identical except where there are opposed relations of origin as there are in the Father, the Son and the Holy Spirit. Only where one proceeds from the other can there be two, for only then a distinctive relation of opposition is realized. Thus the Holy Spirit cannot be the Father because the former proceeds from the latter. Using the logic of Anselm, the Holy Spirit and the Father are identical except in the opposed relation of origin.

[195]Fortman, 174.

Thomas Aquinas (d. 1274) is hailed as the clearest thinker and the boldest innovator in scholasticism. He integrates Aristotelian philosophy with traditional speculative theology. By rethinking and remolding old existing problems, he creates a new and original Christian philosophy. He deals with the problem of the Trinity most thoroughly in his Commentary on the Sentences, Summa Against the Gentiles and Summa Theologiae. For Aquinas, natural reason can neither demonstrate nor know the Trinity. By natural reason, only the unity of essence is knowable, but not the distinction of Persons. There are two origins of Persons, generation and procession. Historically, it is held that the Son is generated by the Father while the Holy Spirit proceeds from either the Father, the Son or both. Aquinas finds analogies of generation and procession in the intellect and the will. For him, a generative act is essentially a likeness producing act. In God the intelligible operation that produces the Word is such a likeness producing act and hence it is called generation. On the other hand, the procession by the will is not by the way of likeness. Therefore it is not generation. So what proceeds in God by the way of love (will) does not proceed as a Son but rather as the Spirit. For the first time, there is a clear cut distinction between generation and procession. Aquinas sets himself to show that there are four

real relations in God—paternity, filiation, spiration and procession. Three of them, paternity, filiation and procession, are really distinct from one another by reason of mutual opposition and thus constituted the three Persons. There are in God two real processions: generation and spiration. There were also oppositions in God which constituted real distinctions, not according to what is absolute, namely essence, but according to what is relative. Aquinas further clarifies two kinds of identities, real and logical. The distinct relations in God are identified with the same essence really but not logically since they differ in concept. For as relations, they denote a respect to another which essence does not say. Therefore, this principle of identity denies a logical identity of the three Persons. Aquinas defines the divine Person as "a rationally distinct subsistent in the divine essence" or simply "a divine Person signifies a distinct subsistent in the divine nature" (De pot. 9.4). The concept of person put as "a distinct subsistent of an intellectual nature" is regarded as the best definition so far. Aquinas was indubitably the author of the most perfect metaphysical synthesis of the Trinitarian doctrine. Some of his doctrines are met with violent opposition at first but were eventually canonized in 1323.

Many medieval thinkers had contributed interesting ideas and innovations to the Trinitarian discussion. One example is William of

Ockham who applies the Ockham razor to trim away what he considers as unjustified multiplication of entities, distinctions and formalities. Overlooking the history of Trinitarian thinking from a panoramic perspective, it can be said that the main tenets of the doctrine had not varied radically since Aquinas. We observe that later theologians accomplished little more than introducing variations of the old themes.

The Reformation Period

Martin Luther speaks of the Trinity only in matters related to faith and salvation. He believes that a Christological approach to the doctrine of the Trinity is the only one that is compatible with this theology.

Melanchthon in his Loci Communes in 1555 gave the meaning of person as "an essence, a living thing in itself, not the sum of many parts but a unified and rational thing which is not sustained and supported by any other being as if it were but an addition to it."[196] To him, the divine Persons were only functionally distinct.

John Calvin reaffirms the traditional doctrine of "one essence and three persons." He defines a divine Person as "a subsistence in the divine essence, which is related to the others and yet distinguished from them by an incommunicable property."[197] However Calvin distinguishes himself in seeing the Trinity in a soteriological and economic context. He speaks in the language of "Trinitarian economy" and "divine operation" and tries to make sense of the Trinity in terms of the divine-human relationship of man's salvation history. Calvin understood the Scripture to attribute to the Father the effective principle of the divine operation (*principium agendi*) meaning

[196]Ibid., 240.

[197]Ibid., 241-242.

that the Father is the source of all that God does. This way, the Son is the wisdom, counsel and ordered arrangement (*sapientia, consilium, agendis dispensatio*) contrasting the Spirit as the strength and power (*virtus, efficacia*) of the divine operation.[198]

The Modern Period

Immanuel Kant rejects any unique revelation of religious truths. For him, claims to knowledge have to be limited to the experiential world shaped by the rational mind. He regards the doctrine of the Trinity as of no practical value.[199]

Friedrich Schleiermacher (1768-1834) is the father of liberal theology. He deems the theology of the Trinity unsatisfactory because it is not an immediate utterance concerning Christian self-consciousness. He disagrees with the orthodox Trinitarian thesis of three Persons in one essence. He believes that the Persons can only be presented in a gradation. Thus one may represent the unity of essence as less real than the three Persons, or vice versa. Schleiermacher seeks to establish theology as a strictly empirical discipline. He organizes theology around a single

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[198]Philip Walker Butin, Revelation, Redemption, and Response (New York: Oxford, 1995), 51-53.

[199]Immanuel Kant, Religion within the Limits of Reason Alone, translated by Theodore M. Greene and Hoyt H. Hudson (New York: Harper and Row, 1960), 132-138.

principle, Jesus Christ, and reduces the Trinity to a second ranked doctrine.[200]

G. W. Hegel (1770-1831) was the greatest German idealist. He develops a philosophical Trinitarianism based entirely on philosophical premises. In his Philosophy of Religion, he claims that God eternally produces himself in the form of the Son, distinguishes himself from himself. The relation between the Father and the Son is expressed in terms of organic life. Hegel reduces the Trinity to a relation among the Father, the Son and the Holy Spirit. In his system, the Father is an abstract God, the universal, the eternal, all-embracing, total particularity. The Son is the infinite particularity and manifestation. The Spirit is an individuality as such. However, all three are spirits.[201] Although Hegel may have incorporated immanent distinctions in the Triunity of God, many theological problems are still left unanswered. For instance, it is not clear why there are three and only three relations in the Hegelian Trinity. Hegel's formula is different from the traditional doctrine in that (1) the Son has finite existence and that (2) economic Trinity is abandoned.

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[200]Friedrich Schleiermacher, The Christian Faith (Edinburgh: T. & T. Clark, 1928), 738-751.

[201]Georg Wilheim Friedrich Hegel, The Christian Religion: Lectures on the Philosophy of Religion (Missoula, MT: Scholars, 1979), 67-99.

Karl Barth (1886-1969) has been called the most important and influential Protestant theologian of our generation. The Barthian doctrine of the Trinity was rooted on God's revelation since, according to Barth, apart from the Scripture God was not knowable. He opposes the search for *vestigia trinitatis*,

> The expression (*vestigium trinitatis*) presumably originates with Augustine and means an analogue of the Trinity, i.e. of the Trinitarian God of the Christian revelation, in this or that reality which is distinct from Him and therefore creaturely, a creaturely reality such that, not as an assumed form of God in His revelation, but quite apart from God's revelation, in its own creature-like structure, it shows a certain similarity to the structure of the Trinitarian concept of God, and is therefore to be regarded as a copy of the Trinitarian God Himself.[202]

Thus analogy has no place in the Barthian Trinitarian discourse. Turning to the three-in-oneness, Barth declares that God is one in his three modes of existence—the Father is the Creator, the Son the Reconciler and the Holy Spirit the Redeemer. He also maintains that there are both an immanent and economic Trinity as well as conformity in the content between the two in most traditional Trinitarian doctrines. God's threeness and oneness is founded on the relations of origin or processions. The perichoresis of the three in one another which is not only a *Nebeneinander* (along each other) but also an *Ineinander und Miteinander* (into and with each other). To

[202]Barth, 384.

Barth the Trinity is necessarily a mystery. Barth make his most important contribution to the Trinitarian doctrine in concluding that the doctrine of the Trinity is grounded in the self-revelation of God in Jesus Christ.

Rudolf Bultmann (1884-1976) has been called one of the most creative and influential theologians of the twentieth century. As a professor in the University of Marburg, he is known for his historical and interpretative writings on the New Testament. Bultmann is not primarily concerned with the Trinity. He is concerned with God as He has revealed Himself in the Christ-event. The doctrine of the incarnation of the Word is a myth. In the scheme of demythologizing, instead of the Word as a divine being consubstantial with the Father, it was a Word of Address (*Anrede*) through whom the Father speaks. The Holy Spirit is as much of a myth as the Word. Bultmann's existentialist theology capitalizes on the significance of human decisions. The traditional doctrine of the Holy Spirit as an indwelling power was a myth that deprives man of the capacity for free response. The demythologized Spirit on the other hand signifies the possibility of a new life which is appropriated by a deliberate resolve. Bultmann is widely criticized for demythologizing the Gospel message. But

he is also praised for communicating the message of the Gospel intelligibly to modern man.[203]

Emil Brunner (1889-1966) raises skeptical questions against the validity of the concept of the Trinity. He denies that Trinitarianism is contained in the Bible. To him, the doctrine of the Trinity is an aberration of theological thinking. He also questions the validity of the statement in the Athanasian Creed, "*una substantia, tres personae*."[204]

Paul Tillich (1886-1965) distinguishes between substance and form. His multileveled analysis is responsible for the decline of religion in the 19th and 20th centuries.[205] Tillich's description of God is controversial. For him, God is simply the ground of being. "Personal God" did not mean that God was a person. It means that God is the ground of everything personal and carried within Himself the ontological power of personality. He is not a person, but He is not less than a person.[206] Christ is not God, but a divine

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[203]Fortman, 264-266.

[204]Emil Brunner, The Christian Doctrine of God, Dogmatics: Vol. I, translated by Olive Wyon (Philadelphia: Westminster, 1959), 222-227.

[205]Charles P. Henderson, God and Science (Atlanta: John Knox, 1986), 125-126.

[206]Paul Tillich, Systematic Theology (Chicago: Chicago, 1957), 121-125.

being. If Christ is not God, Tillich's God cannot be the triune God of orthodox Christianity.[207]

In the late 1960, a new theological approach called the theology of hope emerged. This approach is resurrection-centered. Christ's resurrection is the inauguration of the coming Kingdom. The most prominent leader of this movement is Jürgen Moltmann. In his Theology of Hope published in 1967, Moltmann projects an apocalyptic vision of the Scripture. For him, eschatology is the central concept from which everything else in Christian thought is set. For example, traditional Christology stipulates that the second person of the Trinity is eternal. But for Moltmann, Christ is a merely a Bearer of the future. When God's promises have been fulfilled, Christ's function and deity will be at an end. To Moltmann, the Trinity is a historical event that happened on the cross, a shorter version of the passion narrative of Christ. Moltmann calls his theory the "Trinitarian panentheism." He denied any eternal triune life of God.[208] Another theologian of hope, Wolfhart Pannenberg rejects that Jesus claims to be the Messiah during His earthly ministry. He attributes the claims of Messianic authority of Jesus to the early Christian community. Indeed, according to Pannenberg, divine

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[207]Ibid., 138-145.

[208]Stanley J. Grenz and Roger E. Olson, 20th Century Theology: God & the World in a Transitional Age (Downers Grove, IL: InterVarsity, 1992), 179-180.

sonship is not exclusively owned by Jesus. Other before and after Jesus can also participate in that form of relating to God as Father.[209]

Alfred Whitehead's metaphysics lays the foundation for process theology. One of the most prominent process theologians was John Cobb. In this school of thinking, Nature is a synthesis of two fundamental principles, the abstract potentiality and practical actuality. God, as an essentially immanent deity, was dipolar in nature. The process thesis tends to equate God the Father with the whole of the Godhead and tries to find a place for the other two Trinitarian persons. Cobb, for example, identifies the Son with the primordial Nature and the Spirit with the consequent Nature. In process thinking, history is dynamic and is moving toward a *telos*. A typical illustration is to say that one never stepped into the same river twice. Whitehead uses the term "prehension" to speak of the movement from past to present, that is, of the relatedness of each occasion to the antecedent universe.[210] To use Whitehead's terminology, the past prehends the present, the primordial Nature prehends the consequent Nature. Cobb will say that the Son prehends the Spirit. Needless to say, process theology bears no

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[209]David L. Smith, A Handbook of Contemporary Theology (Wheaton, IL: Bridge Point, 1992), 145.

[210]Alfred North Whitehead, Modes of Thought (New York: Macmillan, 1966), 150-151.

resemblance to orthodoxy. Critics such as Wolfhart Pannenberg call it a form of monarchianism.[211]

There is a resurgence of the Trinity debate in recent times. One interesting development is the use of the concept of time. Charles Heinze wrote,

> Time demonstrates otherness and identity in its three tenses: future, present, and past. There is no confusion between the three. Each is distinct from the others. … Time is inseparably three: there is plurality in time. However, time demonstrates unity, as all tenses are aspects of the same phenomenon.[212]

Modeling after the triunity of time, Heinze likens the Father to the future, the Son to the present, and the Spirit to the past. In this analogy, the Father is the source. The Son proceeds from the Father and the Spirit proceeds from the Father through the Son.[213] Heinze's intuitive approach is too simplistic to be credible. The analogy of time breaks down when the punctiliar nature of the present is compared to the infinitude of the past and future. If time were represented as a number line, the present is a mathematical point. The orthodox Trinitarian doctrine dictates that the Father, the Son and the Spirit

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[211]Grenz, et al., 130-144.

[212]Charles Heinze, Trinity and Triunity (Dale City, VA: Epaphras, 1995), 8-9.

[213]Ibid., 10-11.

must be co-essential in terms of their infinitude. Heinze's system fails to harmonize with the doctrine in this and many other aspects.

The analogy of time is more systematically treated in Robert Jenson's theology. For Jenson, "the chief theological task is the *identification* of God."[214] He analyzes the tensed relationship of the three Persons of the Godhead and comes to the conclusion of identifying the Trinity as the three arrows of time.

> If we think of an identification as a pointing operation—as in "Which one? That one"—we must point with all three time's arrows, in order to point out this God. The identification is triple—rather than, say, double or quintuple—because time just does have three arrows. The past, present, and future of all that is, is doubtless a peculiar sort of fact, but is also the most inescapable.[215]

He interprets "hypostasis" as "identity" which picks out personal existence; while "ousia" is a *persisting* one identity, a persisting *something*. Deity, with all other divine attributes, is predicated of the divine *activity* toward us. Eternity is an openness to the future, a coherence of past and future in temporality.[216] Time has a priority in the direction of the arrow. Jenson thinks that identities of divine Persons are relative, not absolute.

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[214]Robert Jenson, "Three Identities of One Action," Scottish Journal of Theology, vol. 28, no. 1 (1975), 1.

[215]Ibid., 4.

[216]John R. Albright, "The Story of the Triune God: Time and Eternity in Robert Jenson's Theology," Christian Scholar's Review, vol. 16, no. 1 (Fall 1996), 41-42.

> Thus each identity has its priority. The Son is epistemologically prior. The Father has ontic priority: he is the given Transcendence to Jesus, and the given of hope and love. But the Spirit has the metaphysical priority: the only definition of God in the Scripture is that "God is Spirit." It is the structure of priorities that is the substantiality of God.[217]

Jenson's logic of time is more than just a reiteration of the common sense view. Eternity, taken as a temporal coherence of time's arrows, implies that God's intrapersonal relationship is a nexus of priorities based upon a circular concept of time.[218] Jenson has alluded to the synthesis of time and eternity. He may not have fully appreciated this concept since he does not develop it further.

Ted Peters is another theologian who tries to apply the concepts of time and eternity to explain the Trinity. Like Jenson, he also thinks that eternity is the whole of time. He distinguishes his view from those of Plotinus and Pannenberg by upholding everlasting temporal successions and durations. Eternity is "the integration of parts and whole and the consummation of temporal history."[219] Peters proposes five Trinitarian thesis,

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[217]Jenson, 13.

[218]Jenson, Christian Dogmatics, 135-161.

[219]Ted Peters, God as Trinity (Louisville: Westminster, 1993), 168.

> 1. To understand God as Trinity in the economy of salvation requires that God be both temporal and eternal. … 2. The eschatological future is the key that opens the gate to eternity. … 3. There need not be a split between the absoluteness and relatedness of God if we think of God as the absolutely related one. … 4. A concept of the Trinity must be based in part on distribution of functions in order to maintain the beyond-intimate paradox in the one God, but it must be remembered that the beyond-intimate paradox comes to expression in each of the originary symbols individually. … 5. The image of the immanent Trinity ought not be used as a model for human society; rather, we should seek to transform human society on the basis of our vision of the coming kingdom of God in which God alone is the absolute. … 6. The doctrine of the Trinity provides the framework for understanding the dynamics of divine grace.[220]

Peters makes an important contribution by mentioning the complementary nature of the parts-whole relationship between time and eternity. But his thesis is still incomplete in that his concept of eternity is limited to the relationship between God and creation. Eternity is an essential attribute of God apart from creation and must be analyzed in terms of perichoresis. Peters restates the Trinitarian thesis as a form of holistic trichotomy without proof. His theses are designed in the spirit of *theologia viatorum* and are not apt to propel the doctrine of the Trinity to a higher understanding.

T. F. Torrance is one of the theological giants in this century. His theology is primarily an expression of the Nicea and Chalcedon confessions. He tries to resolve the Filioque controversy by emphasizing that the doctrine

[220]Ibid., 178-187.

of the Monarchy is common to all three divine Persons. The doctrine of the περιχ□ρησὶ of the three Person, or their reciprocal containing of one another, helps to lay an ecumenical foundation. The oneness and threeness of God has no priority over one or the other.[221] The Trinity is an eternal relationship. The three Persons are not just "modes of existence" (τρόποι ὑπάρξεως), but substantive relations (σχέσεις οὐσιώδεις).[222] Torrance, like Barth in his spirit of *trinitatis mysterium*, maintains that the mystery of God's internal relationship is "ineffable and far beyond our understanding."[223] We can speak of this eternal relationship "only in negative terms as subsisting substantively (οὐσιώδως) in God beyond beginning (ἀνάρχως), beyond time (ἄχρόνως), beyond cause (ἀναιτίως), beyond explanation (ἄνεκδιηγήτως)."[224] Torrance's Barthian apologetics is consistent with his philosophy of apophatic logic. There is always a danger in asserting an impossibility theorem such as *trinitatis mysterium*. It is no reason why the Trinity cannot in principle be understood at least in degrees. If theology hangs on the concept of the

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[221]T. F. Torrance, Trinitarian Perspectives (Edinburgh: T. & T. Clark, 1994), 125-126.

[222]Ibid., 134.

[223]Ibid.

[224]Ibid., 135.

Trinity like Torrance has said, then we must try to go beyond a murky understanding of it.

Personal Comments

A brief survey of the history of doctrine reveals that the theological concept of Trinitarianism did not come about overnight in a straight forward manner. The growth of Trinitarian knowledge seems to have reached a plateau after Aquinas. There has been no significant improvement on the concept of the Trinity in the post-Aquinas period. Recent works mostly reiterate old concepts in the modern languages. Confusions are not mitigated by meandering rhetoric with all its hypnotizing power of loquaciousness. Sadly we are not farther ahead now than we were a few centuries ago.

It helps to remember that the orthodox Trinitarian doctrine contains extra-biblical concepts, such as the philosophy of *substantia* and *persona*. Although Trinitarianism is rooted in the Scripture, the Scripture by itself does not elucidate Trinitarianism. Philosophy brings reason into the object of our faith. The nature of faith requires a cognitive commitment to what appears to be mysterious. Many theologians, especially those from the camp of Reformed epistemology, hold the view that faith and reason are not necessarily incompatible. The nature of systematic theology necessitates the

integration of all relevant materials of both the biblical and extra-biblical origins.

So far there is no real satisfactory theories for the perichoresis of the Godhead and the three-in-oneness problem. As Karl Rahner has protested, classical Trinitarianism left us something to be desired:

> The venerable classical doctrine of the "vestiges" and the "image of the Trinity" in the world is thought to be—though one would never explicitly say so—a collection of pious speculations, unobjectionable once the doctrine has been established, but telling us nothing, either about the Trinity itself or about created reality, which we did not already know from other sources.[225]

Even though Rahner's criticism of vernacular repetitions may be candid, we shall not overlook the achievement of the classical doctrine in at least identifying the essential elements of Triunity. The doctrine of the Trinity is supported by biblical data. The authority of the Scripture gives weight to the doctrine of the Trinity. Furthermore, if theological integrity is taken to be preserved throughout church history by the sovereignty of God, the orthodox view of the Trinity is deemed trustworthy. The Trinitarian doctrine is complete in at least its elemental form, although it may be incomplete in terms of auxiliary refinements. The present goal of theological research of the Trinity is not one of revolution, but revitalization.

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[225]Karl Rahner, The Trinity, translated by Joseph Donceel (New York: Herder & Herder, 1970), 14.

Rethinking the Trinity

In this section, I will try to refute several misconceptions of the Trinity. Positive observations are made which may improve our understanding of the perichoresis.

The Knowability of the Trinity

Barth and Torrance both hold the view *trinitatis mysterium*. There is no compelling reason to think that the concept of the Trinity is beyond our reach other than the claim that a finite mind cannot comprehend an infinite God. On the contrary, I will argue that a finite mind is capable of understanding infinite objects. For example, I, as a finite being with a finite mind, am able to grapple with the concept of an infinite set of real numbers. It is true that a human being cannot possess infinite knowledge. But it does not necessarily mean that a finite mind is ill-equipped to entertain a meaningful concept of infinity.

Barth's and Torrance's view of *trinitatis mysterium* is based on a form of impossibility theorem. In proving a logical impossibility, one must show that, by assuming the contrapositive of the thesis, a contradiction will

ensure. To show that the view of *trinitatis mysterium* is logically tenuous, I will have to show that a belief in the accessibility of the Trinity necessarily leads to a contradiction: Let us say that person A claims to understand the Trinity. What contradiction is deemed possible? I cannot think of one. Indeed, it is generally easier to prove that something is logically possible than to prove that something is logically impossible. Unless Barth and Torrance are able to prove the logical impossibility of the Trinitarian knowledge, it is not incumbent upon us to abandon the search. On the contrary, there is a real distinct possibility that we may be able to form a conceptual understanding of the Trinity at least in principle. Such understanding is the goal of the rest of this chapter.

An Agreed Statement on the Trinity

Before we delve into the mysterious nature of God *ad intra*, it is good to review the orthodox confession of the Trinity so that there is a concise theological agreement from which the rest of the discussion can progress. Torrance condenses the highlights of the doctrine of the Trinity into an agreed statement in Trinitarian Perspectives.[226] The essence of the doctrine of the Trinity is that the three divine Persons are uncreated, consubstantial

[226]Torrance, 115-122.

and coeternal. The Father, the Son and the Holy Spirit are equal in three most perfect Subsistences (ἐν τρισί τελειοτάσεσιν ὑποστάσεσιν), that is, in three perfect Persons (ἤγουν τρισὶ τελείοις προσώποις). They denote three distinct Persons or real Hypostases which are neither exchangeable nor interchangeable. All three Persons are coeternal and coequal. They are all perfectly one in the identity of their nature and perfectly consubstantial in their being. The Trinity is perfectly homogeneous and unitary, conjoined in all their distinctiveness, for the entire Godhead resides in each Person. There is only one form (εἶδος) of Godhead. Thus the Son reveals the Father as his complete image, and the Spirit does the same to the Son. The Son is eternally begotten of the Father and the Spirit eternally proceeds from the Father and abides in the Son.[227] Regarding hierarchy, the baptismal formula defines an ordering relationship—the Father first, the Son second and the Spirit third. In light of the eternal perichoresis (περιχώρησις), the three divine Persons coindwell and coinhere in each other. The unity of three Persons eternally dwells in the Godhead. This orthodox statement is essentially the same as the Nicea and Chalcedon confessions.

Eternity and the Trinity

Both eternity and the Trinity are unique attributes of God. There is no other being who is eternal and triune. In light of this uniqueness, a case can be made to identify eternity and triunity as complementary attributes. This proposal of divine complementarity will be explained in terms of a critical analysis of the concepts of time and eternity as follow.

The biblical word "everlasting" from Hebrew עוֹלָם and Greek αἰων or ἀίδιος (Rom. 1:20) literally translates as "long duration."[228] The Bible does not allude to timelessness. A timeless eternity is originally a product of platonism. Plato in Timaeus claims that form lacks any duration.[229] Aristotle on the other hand thinks that eternity is everlasting. Origen is the first to introduce platonism into systematic theology. Augustine sees time as movement and change and eternity is no change at all (City of God 11.6). Time is a part of creation. God is unchanging. Boethius states that eternity is the "complete possession all at once of illimitable life" (*interminabilis vitae tota simul et perfecta possessio*).[230] Both Boethius and Aquinas

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[227]Torrance's move in defining the eternal relationship between the Son and the Spirit as "the Spirit abiding in the Son" is possibly motivated by an ecumenical spirit which seeks to resolve the *filioque* controversies.

[228]Alan Padgett, God, Eternity and the Nature of Time (New York: St. Martin, 1992), 24-35.

[229]Ibid., 41.

[230]Brian Leftow, Time and Eternity (Ithaca: Cornell, 1991), 147.

believe that eternity implies immutability and vice versa.[231] Kant accepts the traditional doctrine of eternity. Hegel replaces being with becoming. To him, spirit is eternal but not absolutely timeless. Stump and Kretzmann interpret eternity as infinite duration. Yet they intuit that a life possessed in the best way is a life all of which is present. Hence they invent ET-simultaneity to resolve the conflict between time and timeless eternity. ET-simultaneity consist of two parallel strips running along side each other. The upper strip is eternity, the lower time. Each point on the lower strip is simultaneous with the whole upper strip.[232] ET-simultaneity implies that time and eternity have separate existence. God is wholly simultaneous with each moment in time but not himself a part of time. Timelessness is compatible with simplicity and immutability. In order to guard this compatibility, one may want to say that eternity is timelessness. But the concept of a timeless God is also rife with contradictions. The most common criticism is one focused on the inability of a timeless God to relate to a temporal creation. Another objection to a timeless God stems from a problem with divine introspection. To introspect is to entertain a thought of one's thoughts. A thought is taken to be a set of propositions plus a rational

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[231]Ibid., 149-150.

[232]Ibid., 115-165.

organization. Generally, the introspection of a thought A is logically subsequent to the thought A itself. A timeless God is capable of one and only one thought all in one instance by definition. Now suppose that A is the total sum of God's thought. Then the introspection of A cannot be a part of A since every introspection is logically subsequent to its object. If introspection is not a part of A, it is not a part of God's thought. This counter-example proves that God cannot introspect all of His thoughts in one timeless instance because something cannot be a part and the whole all at the same time. This contradiction is similar to problem of "the set of all sets." Of course, if one is willing to relax the requirement of absolute timelessness, one can remove the enigma by introducing a tensed relation in divine introspection. For instance, we can modify the above scenario as "God introspects thought A of time t_n at time t_{n+1}." By this, I do not imply that the concept of timelessness is bankrupt. I simply try to show that timelessness alone is an incomplete concept. The idea of timelessness has certain theological virtues in terms of harmonizing simplicity and immutability. But the idea of God as a timeless being needs adjustments.

God's personhood is compatible with the concept of time. Personhood is temporal. A person thinks. Thoughts exist either in time or

out of time. Again, a thought is taken to be a collection of propositions superposed by a rational organization. A book holds a set of thoughts timelessly. Yet we do not attribute personhood to a book since a book does not think. Personhood is not just the timeless existence of a set of thought. If the entirety of God's thoughts is conceived in a timeless present, God's personhood at first glance is dangerously close to be called a platonic universal. A person cannot think of all his thoughts in one instance as I have shown before. This statement can be proven analytically. Let *A* be the set of all possible thoughts and *a* is an element of *A*, $a \in A$. Suppose it is the case that a person P thinks all his thoughts in one timeless moment. By thinking timelessly, P conceives of a thought of all thoughts. Timeless thinking implies that $\{a\} = A$. In other words, a timeless person is capable of holding only one thought. It leads to a contradiction: in the act of beholding, the subject is one thought and the object is another. At least two thoughts are needed in beholding. The subject-object relation in the case of introspection is possible if and only if it is tensed as I have argued. Therefore it is a logical impossibility to think all thoughts timelessly.

So far, in my arguments for the necessity of time in the act of divine introspection, God's thoughts are taken to be basically propositional. Critics may question the validity of this assumption. Some Thomist philosophers

try to preserve God's simplicity by rejecting the role of propositional complexity in the theory of divine knowledge. William Alston goes as far as to say that God's knowledge does not include any beliefs (propositional attitudes). In his opinion, God's knowledge is taken to be an intuitive whole and is not "parceled out in separate facts."[233] Nonetheless Alston has overlooked an obvious fact—*i.e.* God speaks in terms of propositions in the Bible. Alston also contradicts himself when he says in one place that "there can be no case for supporting that God's knowledge involves beliefs"[234] and in another "God can have beliefs only as components of knowledge."[235] Self-contradicting statements such as these suggest that the rationality behind the argument is not totally clear. The fact is that there is simply too much exegetical evidence to support the view that God thinks and speaks in propositions. Alston has not succeeded in proving his thesis of the propositionless divine knowledge.

The conflict between omniscience and timelessness is a commonly overlooked problem. Omniscience is normally taken to be God's ability to know all things all at once. Norman Kretzmann has identified a counter-

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[233]William P. Alston, Divine Nature and Human Language (Ithaca, NY: Cornell, 1989), 183.

[234]Ibid.

[235]Ibid., 190.

example which shows that omniscience and immutability are incompatible. In his argument, there is at least one thing an omniscient God cannot know timelessly, namely what time it is.[236] In response, omniscience does not have to be a *timeless* knowledge of all things. If a divine thought is taken to be an infinite set of timeless propositional facts superposed by a temporal rational organization, then God's thought is said to be omniscient in each moment even as it progresses through time. In other words, God's thought at times t_n and t_{n+1} differs not in its factual content but only in its rational organization. This way, God, in spite of His omniscience, knows what time it is because God is aware of time through His temporal thoughts. In addition, God's immutability is preserved because the timeless factual content of His thought does not change through time.

The concept of the Trinity constitutes a rich theoretical structure which is conducive to resolve the enigma of eternity and personhood in our concept of God. On one hand, timelessness which offers a coherence with simplicity and immutability is a theoretical necessity. On the other hand, personhood is meaningful if and only if it exists in time. At this point, the concept of the Trinity comes to rescue. First, God exists in time because He

[236]Norman Kretzmann, "Omniscience and Immutability," Philosophy of Religion: Selected Readings, edited by William L. Rowe and William J. Wainwright (New York: Harcourt Brace Jovanovich, 1973), 60-70.

is personal. At the same time, all His thoughts also exist immutably because the omniscient God cannot be surprised by new data. Beginning with God's timeless unity, we ask the question, "What happens when God introspects His own mind?" The answer is disjunctive: Either God introspects all His thoughts at once, or He introspects only a part of His thoughts. In the first case, we encounter the same contradiction of timeless thinking as before. Therefore, it is shown that God can introspect only a part of His thoughts *reductio ad absurdum*. Partial conception leads to the existence of time in the Godhead. Since God can "see" only a part of His mind, He must "move" among His thoughts in order to traverse His mind. Next, all God's thoughts must be logically connected. On the ordered connectivity of mental states, James Clerk Maxwell wrote,

> And yet if we conceive of the mind as absolutely indivisible and capable of only one state at a time, we must admit that these states may be arranged in chronological order, and that this is the only real order of these states.[237]

I extend Maxwell's analysis to the mind of God's in which thoughts progress linearly through an ordered chain of reason. Perfect thoughts are logically connected. God's mind is an infinite nexus of logical causality. Even in the case of the freedom of the will, a free thought is nevertheless

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[237]P. M. Harman, The Scientific Letters and Papers of James Clerk Maxwell, vol. 1 (Cambridge: Cambridge, 1990), 377.

freely chosen by the will and is hence caused. Each thought is irrevocably pre-determined by its antecedent which is either a thought or a will. God is a free agent. There must exist a way to transcend the infinite chain of causality. Freedom presupposes the ability to choose. Free choices presuppose a degree of uncertainty. If I can predict with absolute certainty that I am going to do A tomorrow, then I am not free to not do A. Generally speaking, uncertainty is essential for freedom. The uncertainty of freedom in the Godhead is embedded in those parts of the divine reason which are opaque to divine introspection.

The logical linearity of God's thoughts defines an arrow of time. God possesses the logical present in the act of introspection. The arrow of time is thence partitioned into three unexchangeable segments of past, present and future. Each segment is personal since it constitutes God's living thoughts. The partition of past, present and future in the Godhead is what we call the Trinity. The logical structure of the Trinity is a corollary of God's eternity. No other creature is eternal. No one beside God is triune. Time is a mental property, not a real thing. Time exists in the mind of God, but not vice versa. Eternity is a synthesis of time and timelessness. Eternal Trinity is a unified theological concept.

A Mathematical Representation of the Trinity

The language of theology is words and science mathematics. Words are primarily designed to point to human experiences. Many theological terms are invented to enhance the theologian's ability to communicate abstractions. The meaning of words nevertheless cannot extend beyond everyday analogies. Augustine believes that an analogy of the Trinity cannot be found in creation. He resorts to the abstraction of the human mind to find analogies. The human mind, though more abstract than corporeal objects, is nevertheless not triune and subsequently cannot facilitate mental Trinitarian analogies. Mathematics on the other hand does not point to anything human. It is a language of pure thought. The structure of mathematical objects offers the abstraction, purity and elegance needed to represent the nature of the Trinity.

A mathematical representation tries to capture the structure of an abstract concept. A representation is interpretative. Mathematics is useful to model abstract relations too abstract for words to express. In appendix 1, I show a mathematical analogy of the perichoresis of the coessential, coequal and coeternal Trinity based on abstract group theoretic structures. By so doing, I have not added anything new to orthodoxy. I simply wish to

mollify the dogmatism of *trinitatis mysterium* which is so religiously defended by my predecessors. However no claim is being made to have exhausted the knowledge of the Godhead. An analogy, mathematical or not, is only useful to illustrate reality but is not the Reality itself.

Conclusion

The purpose of this chapter is to formulate a coherent theory of the Trinity. Eternity is taken to be the synthesis of time and timelessness. Eternity and the Trinity are complementary concepts. I have shown that eternity logically leads to Triunity. I have also explored the use of pure mathematics in representing the nexus of the abstract perichoresis. My Trinitarian statement does not deviate from the confession of Nicea and Chalcedon, but only serves to elucidate what is commonly referred to as the ineffable and impenetrable.

CHAPTER 5

THE UNFINISHED WORK OF EINSTEIN

God is eternal and triune. Eternity and triunity are complementary concepts as I have argued in chapter 4. On the other hand, creation is not eternal and therefore is not essentially triune. Nevertheless the Creator God could have installed a Trinitarian representation in the fabric of the physical universe. The Apostle Paul proclaims that the creation is a representation of God's divine nature (θει⌣τὴ) in Romans 1:20. Hence, the law of physics may reflect a Trinitarian pattern on the metaphysical level. This Trinitarian pattern will be generalized as the Trinitarian Principle (TP) in the following sections. In this chapter, I will discuss the practical aspects of implementing theology in science.

Grand Unification Theories (GUTs)

After Einstein had formulated general relativity in 1925, he spent the rest of his life searching for a unified field theory unsuccessfully. His search

for unification was motivated by a sense of the oneness of God.[238] Einstein's immediate concern was to formulate a geometric theory of electromagnetism similar to that of gravitation, even though he had also fleetingly entertained the possibility of incorporating Bohr's quantum orbits in general relativity.[239] Einstein's relentless search for a unified field theory is regarded by many physicists as a blunder and an anomaly of his genius. Nobelist Emilio Segrè has some unsympathetic words to say about the autumn years of Einstein's life,

> With the arrival of Nazism, Einstein finally emigrated from Germany, where he would undoubtedly have been killed, and after some peregrination, settled at the Institute for Advanced Study at Princeton, New Jersey. The flame of his genius was weakening, and Einstein, who for decades had seen farther ahead than anyone else who had introduced some of the most profound and fruitful ideas in physics, devoted himself to problems that seemed to have no solution and perhaps were wrongly posed. The guiding light of new physics that had come from Berne, Zurich, Berlin did not continue from Princeton.[240]

Many physicists are now deliberating whether unification theories should be classified as physical science. The typical energy for the effects of GUT to be observable is in the order of 10^{14} GeV which is in principle unattainable technologically. Theories which cannot be verified experimentally are

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[238]Banesh Hoffmann, Albert Einstein: Creator and Rebel (New York: Plume, 1972), 228.

[239]Ibid., 231.

[240]Emilio Segrè, From X-rays to Quarks (New York: Freeman, 1980), 100.

banded as non-science by physicists. The spirit of the scientific Renaissance reverberating in the motto of the Royal Society as *Nullius in verba* (Take nobody's word for it) speaks clearly of the value of verificationism in the scientific community.[241] It is thought that the end of verificationism is a precursor of the end of science. Regarding the remoteness of GUT, Banesh Hoffmann asks,

> Where were the comparable guiding principles that could lead to the unique construction of a unified field theory? No one knew. Not even Einstein. Thus the search was not so much a search as a groping in the gloom of a mathematical jungle inadequately lit by physical intuition.[242]

Despite the threat of futility, many young physicists today are following the example of Einstein by expending the prime of their youth in the search of a GUT. So far there are only four fundamental forces known to exist in Nature: the strong force, weak force, electromagnetism and gravity. The current standard model of GUT is usually taken to be the unification of the strong, electromagnetic and weak forces. This model, proposed by H. Georgi and Glashow, is based on the assumption that the new symmetry which emerges when the three forces are unified is given by the special

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[241]Jefferson Hane Weaver, The World of Physics, vol. 1 (New York: Simon and Schuster, 1987), 31.

[242]Hoffmann, 227.

unitary group SU(5).[243] SU(5) can be taken to be a shorthand notation for the Georgi-Glashow GUT. In the event of a spontaneous symmetry breaking shortly after the Big Bang, SU(5) breaks down into $SU(3) \times SU(2) \times U(1)$ where SU(3), SU(2) and U(1) are symmetry groups corresponding to the strong force, weak force and electromagnetic force respectively. One of the most serious weaknesses of the Georgi-Glashow theory is that gravity is not incorporated. This theory also predicts proton decay which is yet to be observed. At the theological end, SU(5) is not TP-compatible neither because the fundamental forces were unified only for a brief moment prior to the point of symmetry breaking after the Big Bang but are not unified at all times. TP-compatibility requires that a correct unification theory must incorporate unity and distinctness all at once at all times. This concept will be further explained in the next section. Due to these shortcomings, SU(5) is deemed an incomplete theory.[244] Today most GUT theorists have turned from SU(5) to the superstring theory. In spite of its popularity among field theorists, many physicists are still skeptical of the superstring theory. Richard Feynman is candid about his unease,

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[243]Sybil P. Parker, McGraw-Hill Encyclopedia of Physics, 2d ed. (New York: McGraw-Hill, 1991), 502.

[244]P. D. B. Collins, A. D. Martin and E. J. Squires, Particle Physics and Cosmology (New York: Wiley, 1989), 158-186.

> I don't like that they're not calculating anything. I don't like that they don't check their ideas. I don't like that for anything that disagrees with an experiment, they cook up an explanation—a fix-up to say "Well, it still might be true." … So the fact that it might disagree with experience is very tenuous, it doesn't produce anything; it has to be excused most of the time. It doesn't look right.[245]

After three decades of research, superstring theorists still have not produced a single prediction. Rumors say that superstring theorists are overtly obsessed with mathematical elegance in the expense of physical reality. Superstring is a geometric theory which promises to unify all fundamental forces. At the same time, it introduces other unphysical quantities such the extra 7 dimensions and the super-heavy Planck mass. However there is no harm in experimenting with different ideas. Feynman said, "So we have a large number of experimental facts already collected, for which there hasn't been the imagination to produce a reasonable theory of any of them."[246] Despite its many setbacks, GUT is still hailed by many physicists to be the ultimate intellectual challenge. Irrespective of its esoteric nature, I still believe that a unified field theory is a necessary element of a complete Trinitarian world view. I also believe that the integration of science and theology is severely undermined unless theological principles can be shown

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[245]P. C. W. Davies and J. Brown, Superstrings: A Theory of Everything? (Cambridge: Cambridge, 1988), 194.

[246]Ibid., 195.

to impact scientific theories. In this chapter, I will introduce an alternative approach to GUT integrating quantum mechanics, general relativity and electromagnetism in lieu of SU(5) and the superstring theory. The motivation of this intellectual exercise is to give an example of how the doctrine of the Trinity can *ipso facto* inform theoretical science.

Trinitarian Metaphysics

Hegel's philosophy allows a synthesis of thesis and antithesis. Antithesis is the opposite of thesis. Opposites are defined by relations. In algebra, a and $-a$ are opposite under addition. In logic, A and $\sim A$ are opposite under disjunction. Beside thesis and antithesis, synthesis is also defined by relations. For instance, the synthesis of algebraic opposites under addition is zero, $a + (-a) = 0$; and the synthesis of thesis and antithesis under disjunction, $A \vee \sim A$, is true. These are of course rather banal examples which only serve the purpose of demonstrating the role of relations in Hegelian synthesis. The synthesis in Hegelian idealism which amalgamates thesis and antithesis resides on a higher and more complex level of abstraction. Although Nature appears simple in occasions, the general structures of physical laws are exceedingly profound. To account for the nexus of intricate physical phenomenology, we need to avoid the

obvious and search for the more elegant and abstract relations as the ground of synthesis. Based on a conglomerate of theological considerations such as Romans 1:20 and the prominence of triadic representations in Nature, I propose the Trinitarian relations as the basis of the Hegelian synthesis with respect to modeling the fundamental physical laws of Nature.

In chapter 4 and appendix 1, I explicated the Trinitarian relations in terms of group theoretic in which the sets *V* and *S* are synthesized into *V* but at the same time are neither identical to nor parts of *V*. In physics, I take thesis and antithesis to be "orthogonal duals" in order to create a non-trivial category of synthesis. By "orthogonal duals," I refer to two distinct subsistences which are related in a principle of complementarity. For example, electricity and magnetism are two orthogonal duals which are synthesized into a unified principle through Maxwell's equations. In quantum mechanics, the wave nature and the corpuscular nature of subatomic particles are synthesized through Bohr's complementarity principle. In the more recent developments of theoretical physics, duality is again incorporated into the theories of supersymmetry, supergravity and superstring.[247] Nature is full of such examples of orthogonal duals and their

[247]Edward Witten, "Duality, Spacetime and Quantum Mechanics," Physics Today, vol. 50, no. 5 (May 1997), 28-33.

syntheses. The ontology of the triadic principle of thesis, antithesis and synthesis is sufficiently self-presenting that it ought to be elevated to a law-like status. Combining Hegel's synthesis and the Trinitarian theology, we arrive at a new metaphysics called the "Trinitarian Principle" (TP). In essence, TP states that real ontological objects exist in Nature as triads of orthogonal duals and their synthetic counterparts. The relational structure of TP is the same as the group theoretic structure of the mathematical representation of the Trinity in appendix 1.

The fundamental units of Nature are space, time and mass. Space and time are not real ontological objects but belong to a Kantian category of mental properties as discussed in chapter 3. Therefore spacetime is not subject to TP. Despite this disclaimer, spacetime nevertheless shows the features of TP in that space and time are synthesized into a unified principle of spacetime in special relativity. Mass on the other hand has so far eluded the detection of a definite TP pattern. The dual of mass is energy according to Einstein's equivalence principle $E = mc^2$. But their synthesis is yet to be identified. The synthesis of mass and energy, or mass-energy, is cryptically referred to as "massen" here. Massen is not a field *per se*, although it can be represented as a field. A field is simply a mathematical representation of the interactions of matters and forces in spacetime. A field is not a substance.

Massen on the other hand is a substance because it exists ontologically apart from the limitations of spacetime.

In quantum mechanics, mass is associated with the wavefunction ψ and energy the Hamiltonian $\hat{H}$. In order to synthesize mass and energy, we need a set of equations similar to Maxwell's equations to describe massen. Mass and energy are similar to electricity and magnetism in that mass and energy can causally interchange according to the mass-energy equivalence principle. By referring to the mathematical representation of the Trinity and relating mass to *S*, energy to *G* and massen to *V*, we can model massen as a synthesis of (ε, μ) where ε is an energy field and μ a mass field. The mass field is categorically different from the energy field in that mass is corporeal and energy incorporeal.

The mathematics of the massen field is derived in appendix 2. The advantage of the massen equations is that they make it possible for the Riemann curvature tensor to be expressed as a function of the Schrödinger equation as a way of integrating quantum mechanics and general relativity. The metaphysical presupposition of my version of GUT is the Trinitarian Principle (TP). My strategy is to derive the Maxwell's equations from (1) Gauss' law, (2) the continuity equation and (3) the principle of general covariance. The purpose of this exercise to show that Maxwell's equations

are not based on a mere phenomenological theory but are founded on a set of well defined physical intuitions which have their origin in some sort of Trinitarian pattern. By Trinitarian pattern, I refer to TP in which a set of objects are unified and yet remain distinct all at once at all times as illustrated by the perichoresis of the Trinity. The set of Maxwell's equations is just one example of TP-compatibility in science. The mathematical structure of Maxwell's equations can be extended to other types of field theories. It is possible that the reason of the success of the Salam-Weinberg and Feynman-Schwinger-Tomonaga unification theories is that they are extensions of Maxwell's equations and therefore TP-compatible. Along this spirit, I invent the massen field which manifestly resembles Maxwell's equations in order to guarantee TP-compatibility. Einstein discovered special relativity in the course of investigating the covariance of Maxwell's equations. Technically speaking, special relativity is the brainchild of Maxwell's equations. But Maxwell's equations are also derivable from special relativity. Maxwell's equations are the differential forms of Gauss' law, Faraday-Lenz law and modified Ampère's law. Physicist J. R. Lucas argues that Maxwell's equations can be derived from the Coulomb's inverse square law, the invariance of electric charge and the principle of general

covariance alone.[248] Lucas' derivation of Maxwell equations has been slightly modified and hopefully improved in appendix 2. Given that Maxwell's equations are derivable apart from phenomenology, I may adjust my likewise non-phenomenological approach in the derivation of the massen equations in appendix 2.

Conclusion

The massen equations are originally conceived under the auspice that Trinitarianism may somehow influence theoretical science on a metaphysical level. The attempt to construct a version of GUT based on the metaphysics of Hegelian synthesis and the Trinitarian principle (TP) is itself a theoretical experiment aimed to test the validity of TP. If God has indeed left an Trinitarian imprint in Nature, it ought to reflect in the mathematical theories describing the fundamental principles of the physical universe.

The traditional theoretical impasse of integrating quantum mechanics and general relativity is removed through the massen equations. Quantum gravity is required only in exotic cases in which the curvature of spacetime approaches a singularity as in the case of the Big Bang and the blackhole.

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[248] J. R. Lucas and P. E. Hodgson, Spacetime and Electromagnetism (Oxford: Clarendon, 1990), 202-205.

Most physical phenomena can be approximated by flat spacetime in which relativistic quantum mechanics is sufficient. The theory of massen equations, as an application of TP, provide a theoretical framework for a version of GUT.

CHAPTER 6

SUMMARY AND CONCLUSION

Summary

The goal of this thesis is to identify elements of a theory of integration in the fields of philosophy, science and theology. I define science as a human activity primarily organized around a general emphasis on understanding the underlying structure of the physical universe. Science is not demarcated from other disciplines labeled as "non-science." On the contrary, science must be integrated with theology and philosophy in the search of a unified field of knowledge. Integration is not a luxury but a necessity. Science is a religious duty. A familiarity with the laws of Nature is a great advantage in the study of natural theology.

Realism is compatible with the transcendent reality of God. A sense of rationality is instilled in the created order because the Creator of the universe is a rational being. In my opinion, rational realism is the most reasonable position of the philosophy of science.

Theoretical physics is most directly related to philosophy and theology. In theology, aspects of God which are most relevant to understanding theoretical concepts such as mathematical fields and objects are those that are most abstract, such as the concepts of time, eternity and the Trinity. The concept of the Trinity is the summit of all theological thoughts and is also the guiding principle of constructing unification theories. Before we can apply the concept of the Trinity as a guide to model the created order, we must first have a concept of the Trinity. Along this line of reasoning, much of this thesis is devoted to facilitating a deeper understanding of Trinitarianism. The mystery of Trinity summarized in the formula of "one God, three Persons" is partially resolved by hypothesizing a partition in the Godhead through the act of divine introspection. The essence of this argument is that God cannot know all of His thoughts all at once. The set of thoughts God can introspect at any given moment is congruent to the logical present which separates the logical past from the logical future along the chain of reason. Although all of God's thoughts exist timelessly, God must move in time to traverse all of His thoughts in the Godhead. The oneness of God is timeless, but the threeness of God is temporal. This way, time and timelessness coalesce into a complex principle of eternity. Eternity and the Trinity are complementary concepts. In

appendix 1, the orthodox statements of the Trinity are fully expressed through a mathematical analogy.

A corollary of the doctrine of the Trinity is what I call the Trinitarian Principle (TP). TP is an underlying principle of the laws of physics which reflects the nature of perichoresis. Two fields can be said to be unified and yet remains distinct all at once at all times. One example is electromagnetism described by Maxwell's equations. As an application of TP, I have invented a version of the Grand Unification Theory (GUT) by constructing a set of massen field equations which lead to the integration of general relativity and quantum mechanics. The mathematical derivation of the massen equations can be found in appendix 2.

Conclusion

The biggest challenge in producing a work on integrating science and theology is to bring harmony into an area where there are discords. Science and theology have historically been foes rather than friends. In the United States, the prospect of bringing integration into a public forum is stymied due to the recent politically-correct movement and the separation of the Church and the State. There is a deep sense of despair in the mind of a modern man in the age of science. I think that one of the reasons of this

despair is partially attributed to a great divorce between science and theology which was effected in the last century. Before this great divorce, physicists studied science as a way to know God and they do so with a religious fervor and integrity. Today across the university campuses, idealism is beset with the pressure of making publication deadlines and scrabbling for research money. Occasionally we may run into a few scientists whose eyes still sparkle as they talk about their life—their search for knowledge. In general, modern science has to some extent lost its innocence when it moves from being a religion to becoming an enterprise. If science were to retain its intellectual appeal, it must return to its basics. Science and religion are beautiful insofar as they continue to provide answers to big questions and to generate even bigger questions. Science and religion are both cosmology. Where there is the unity of thought, there is the strength of reason.

APPENDIX 1

GROUP THEORY AND THE TRINITY

I have tried to argue in chapter 4 that pure mathematics is useful in providing analogies for the perichoresis of the Trinity. The purpose of this appendix is to construct such an analogy.

In algebra, the definition of a group is "a set *G* together with a law of composition which is associative and has an identity element, and such that every element of *G* has an inverse."[249] Here I define three groups *V* (*Vater* for Father), *S* (*Sohn* for Son) and *G* (*Geist* for Spirit). The set *V* is defined as

(4.1) $$V = \{a + bi : a, b \in \text{ú} - \{0\}\}$$

where ú is the set of real numbers and $i = \sqrt{-1}$. The law of composition is an outer product $\otimes$ defined as

(4.2) $$(m + ni) \otimes (p + qi) = mp + nqi .$$

[249]Michael Artin, Algebra (New Jersey: Prentice Hall, 1991), 42.

where $m,n,p,q \in$ ú. One can easily verify that *V* forms a group under $\otimes$ with the identity element $1+i$. *S* is defined as

(4.3) $$S = \{ci : c \in \text{ú} - \{0\}\}.$$

It forms a group under $\otimes$ with identity element *i*. *G* is defined as

(4.4) $$G = \{d : d \in \text{ú} - \{0\}\}$$

and is also a group under addition with identity element 1.

Next, we will define a set of homomorphisms on *V*, *S* and *G*. A homomorphism $\phi : G \to G'$ is defined as $\phi(xy) = \phi(x)\phi(y)$ where $x, y \in G$, $\phi(x) \in G'$ and $\phi(y) \in G'$. The existence of a homomorphism implies that *G* and G' have identical group structures. If the map ϕ is chosen to be

(4.5) $$\phi(x) = \text{Im}(x)i,$$

homomorphism $\phi : V \to S$ exists, where $x \in V$. Similarly homomorphism $\psi : S \to G$ exists if ψ is defined as

(4.6) $$\psi(z) = \|z\|,$$

where $z \in S$. Lastly, we construct $\pi : V \to G$ by letting

(4.7) $$\pi(w) = \text{Re}(w),$$

where $w \in V$.

With this construction, *V*, *S* and *G* are all infinitely uncountable sets. They are coequal in the sense that one is not more than the others since one

infinite set is not greater than another infinite set. Furthermore, *V*, *S* and *G* are not subsets of each other; hence they are not and cannot be contained in one another. The impossibility of mutual containment implies that the Son and the Spirit are not and cannot be a part of the Father as it is falsely supposed in monarchianism. The three sets *V*, *S* and *G* are mutually disjoint, $V \cap S = V \cap G = S \cap G = \varnothing$. The partition of the three disjoint sets forms the basis of past, present and future to meet the requirement of the existence of time in the Godhead. Together the union of the three sets is the whole of the complex plain minus zero, $V \cup S \cup G = \div - \{0\}$ where ÷ is the set of complex numbers. The infinity of ÷ is used to model the infinite thought of God. The synthesis of the parts and the whole define the Trinity and eternity as shown in chapter 4. All three groups *V*, *S* and *G* are coessential by virtue of being homomorphic and sharing the same composition law. The law of composition leads to the creation of the three homomorphisms in a natural manner. $V \to S$ corresponds to "the Son proceeds from the Father," $S \to G$ likens to "the Spirit spirates from the Father through the Son," and $V \to G$ is "the Spirit proceeds from the Father." Interestingly, this mathematical model accommodates both sides of the Filioque controversies. There is also an ordering relationship among three in terms of homomorphic priority, $V \to S \to G$.

APPENDIX 2

MASSEN FIELD THEORY

This appendix contains the mathematical derivation of the massen equations introduced in chapter 5. The strategy of the proof is to first derive Maxwell's equations from Gauss' law, the continuity equation and the principle of general covariance independent of any phenomenological considerations. Next, the derivation of the Maxwell's equation in full with the exception of replacing Gauss' law with the Schrödinger equation is used as a model to derive a set of massen equations which look like Maxwell's equations. The massen equations make possible a massen stress tensor by minimal substitution into the electromagnetic energy stress tensor. The result is a Riemann curvature tensor expressed in terms of a wavefunction. At the end, quantum mechanics is incorporated into Einstein field equation in a natural manner. The unification of quantum mechanics and general relativity is an important step toward a complete GUT.

Useful Formulas

(2.1) $$T_{(ab)} = \frac{1}{2}\left(T_{ab} + T_{ba}\right)$$

(2.2) $$T_{[ab]} = \frac{1}{2}\left(T_{ab} - T_{ba}\right)$$

(2.3) $$T_{(a_1 \cdots a_l)} = \frac{1}{l!}\sum_{\pi} T_{a_{\pi(1)} \cdots a_{\pi(l)}}$$

(2.4) $$T_{[a_1 \cdots a_l]} = \frac{1}{l!}\sum_{\pi} \delta_{\pi}\, T_{a_{\pi(1)} \cdots a_{\pi(l)}}\,,$$

where $\delta_{\pi} = +1$ for even permutations and $\delta_{\pi} = -1$ for odd permutations.

(2.5) $$\nabla \cdot (\nabla \times \mathbf{a}) = 0$$

(2.6) $$\nabla \times \nabla \psi = 0$$

(2.7) $$\nabla \times \nabla \times \mathbf{a} = \nabla \nabla \cdot \mathbf{a} - \nabla^2 \mathbf{a}$$

Derivation of Maxwell's Equations

We begin the derivation of the Maxwell's equation with the Coulomb potential for a point charge

(2.8) $$\Phi(r) = \frac{q}{r^2}\,.$$

For a general charge distribution $\rho(\mathbf{r})$, Coulomb potential $\Phi(\mathbf{r})$ is given by

(2.9) $$\Phi(\mathbf{r}) = \int \frac{\rho(\mathbf{r}')}{|\mathbf{r} - \mathbf{r}'|} d^3 r'\,.$$

Apply ∇^2 to both sides of the equation and use the identity

(2.10) $$\nabla^2\left(\frac{1}{|\mathbf{r}-\mathbf{r}'|}\right) = -4\pi\,\delta(\mathbf{r}-\mathbf{r}')$$

where $\delta(\mathbf{r}-\mathbf{r}')$ is a delta function,[250] we arrive at the Poisson equation

(2.11) $$\nabla^2\Phi = -4\pi\rho\,.$$

The electric field **E** is given by

(2.12) $$\mathbf{E} = -\nabla\Phi\,.$$

By combining (2.11) and (2.12), we have the differential Gauss' law

(2.13) $$\nabla\cdot\mathbf{E} = 4\pi\rho\,.$$

In special relativity, charge is assumed to be invariant under Lorentz transformation and is conserved over time. If this assumption is granted, the continuity equation must follow:[251]

(2.14) $$\frac{\partial\rho}{\partial t} = \nabla\cdot\mathbf{J}\,.$$

Differentiate (2.13) with respect to time, we have

(2.15) $$\nabla\cdot\frac{\partial\mathbf{E}}{\partial t} = 4\pi\frac{\partial\rho}{\partial t}.$$

Combine (2.14) and (2.15), we obtain a resemblance of the modified Ampère's law

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[250]John David Jackson, Classical Electrodynamics (New York: Wiley, 1962), 40.

[251]J. R. Lucas and P. E. Hodgson, Spacetime and Electromagnetism (Oxford: Clarendon, 1990), 196-197.

(2.16) $$\frac{\partial \mathbf{E}}{\partial t} + 4\pi \mathbf{J} = 0 .$$

This equation is incomplete because $\frac{\partial \mathbf{E}}{\partial t} = 0$ in the case of a nonzero steady current. Therefore the right-hand side of (2.16) must be missing a term. In light of the differential Ampère's law

(2.17) $$\nabla \times \mathbf{B} = \frac{4\pi}{c}\mathbf{J} ,$$

we intuitively know that the missing term is $\nabla \times \mathbf{B}$. This inference can be made more rigorous mathematically by applying the principle of general covariance. The principle of general covariance says that: (1) The laws of Nature are covariant, that is, form-invariant under all coordinate transformations. (2) The geometry of spacetime is Riemannian. (3) Laws of Nature which are written in a flat spacetime coordinate frame, may be taken over intact by replacing tensors and all tensorial operations, by their curved space generations.[252] For instance, by applying condition (1), the continuity equation can be cast in covariant form as

(2.18) $$\partial_\alpha J^\alpha = 0$$

[252]Hüseyin Yilmaz, Introduction to the Theory of Relativity and the Principles of Modern Physics (New York: Blaisdell, 1965), 152.

with the four-current $J^{\alpha} = (c\rho, \mathbf{J})$. In special relativity, the 4-dimensional generalization of ∇^2 is the D'Alembertian operator $£ \equiv \frac{\partial^2}{c^2 \partial t^2} - \nabla^2$. By applying the principle of covariance, equation (2.11) is generalized to be

(2.19) $$£\ \Phi = 4\pi\rho.$$

In terms of the four-vector-potential $A^{\alpha} = (\Phi, \mathbf{A})$, we can extend (2.19) to two 4-dimensional Poisson equations

(2.20) $$\frac{1}{c^2}\frac{\partial^2 \mathbf{A}}{\partial t^2} - \nabla^2 \mathbf{A} = \frac{4\pi}{c}\mathbf{J},$$

(2.21) $$\frac{1}{c^2}\frac{\partial^2 \Phi}{\partial t^2} - \nabla^2 \Phi = 4\pi\rho,$$

with the Lorentz condition

(2.22) $$\frac{1}{c}\frac{\partial \Phi}{\partial t} + \nabla \cdot \mathbf{A} = 0.$$

In covariant forms, (2.20), (2.21) and (2.22) are written as

(2.23) $$£\ A^{\alpha} = 4\pi J^{\alpha}$$

(2.24) $$\partial_{\alpha} A^{\alpha} = 0.$$

The set of covariant equations (2.23) and (2.24) are equivalent to the Maxwell's equations in all respects.[253] We combine (2.21) with (2.22) to obtain an expression for **E**,

$$\begin{aligned} 4\pi\rho &= \frac{1}{c^2}\frac{\partial^2\Phi}{\partial t^2} - \nabla^2\Phi \\ &= -\frac{1}{c}\frac{\partial}{\partial t}\nabla\cdot\mathbf{A} - \nabla\cdot\nabla\Phi \\ &= \nabla\cdot\left(-\frac{1}{c}\frac{\partial\mathbf{A}}{\partial t} - \nabla\Phi\right). \end{aligned} \tag{2.25}$$

By comparing (2.25) and (2.13), fields **E** is found to be

$$\mathbf{E} = -\frac{1}{c}\frac{\partial\mathbf{A}}{\partial t} - \nabla\Phi\,. \tag{2.26}$$

In the static case, $\frac{\partial\Phi}{\partial t} = 0$ and $\frac{\partial\mathbf{A}}{\partial t} = 0$. Under these conditions, equation (2.20) can be simplified as

$$-\nabla^2\mathbf{A} = \frac{4\pi}{c}\mathbf{J}\,. \tag{2.27}$$

Using vector formula (2.7), we have

$$\begin{aligned} -\nabla^2\mathbf{A} &= \nabla\times\nabla\times\mathbf{A} - \nabla\nabla\cdot\mathbf{A} \\ &= \nabla\times\nabla\times\mathbf{A} - \nabla\left(-\frac{1}{c}\frac{\partial\Phi}{\partial t}\right). \end{aligned} \tag{2.28}$$

Under the static condition, with (2.27) and (2.28), we have

[253]Jackson, 220.

(2.29) $$\nabla \times \nabla \times \mathbf{A} = \frac{4\pi}{c}\mathbf{J}.$$

Compare (2.29) with Ampère's law (2.17), we arrive at the familiar definition of **B** in terms of **A**,

(2.30) $$\mathbf{B} = \nabla \times \mathbf{A}.$$

Take the divergence of (2.30) and apply the vector formula (2.5), we immediate derive the "no magnetic monopole" Maxwell equation

(2.31) $$\nabla \cdot \mathbf{B} = 0.$$

By taking the curl of (2.26) and applying (2.6), we easily derive the differential Faraday-Lenz law

(2.32) $$\nabla \times \mathbf{E} = -\frac{1}{c}\frac{\partial}{\partial t}\nabla \times \mathbf{A} = -\frac{1}{c}\frac{\partial \mathbf{B}}{\partial t}.$$

To derive the modified Ampère law, we take the curl of (2.30) and combine it with (2.7), (2.20), (2.22) and (2.26)

(2.33)
$$\begin{aligned}\nabla \times \mathbf{B} = \nabla \times \nabla \times \mathbf{A} &= \nabla\nabla \cdot \mathbf{A} - \nabla^2 \mathbf{A} \\ &= \nabla\left(-\frac{1}{c}\frac{\partial \Phi}{\partial t}\right) + \frac{4\pi}{c}\mathbf{J} - \frac{1}{c^2}\frac{\partial^2 \mathbf{A}}{\partial t^2} \\ &= \nabla\left(-\frac{1}{c}\frac{\partial \Phi}{\partial t}\right) + \frac{4\pi}{c}\mathbf{J} - \frac{1}{c}\frac{\partial \mathbf{E}}{\partial t} + \frac{1}{c}\frac{\partial}{\partial t}(\nabla\Phi) \\ &= \frac{4\pi}{c}\mathbf{J} - \frac{1}{c}\frac{\partial \mathbf{E}}{\partial t}.\end{aligned}$$

We see here that the mathematical form of Maxwell's equations is a natural consequence of an inverse square law, the continuity equation and general covariance. With these conditions, one may construct another set of equations similar to Maxwell's equations to describe the dynamics of massen, which I call the "massen equations."

Massen Equations and GUT

The exact form of massen equations can be derived by minimal substitutions $\varepsilon \to \mathbf{B}$ and $\mu \to \mathbf{E}$. The purpose of this exercise is to integrate quantum mechanics with general relativity. It behooves us to begin with the formulation of massen equations in terms of quantum mechanics. The mass field μ is closely related to the wavefunction of a particle. Here we will relax the requirement of a inverse square potential Φ because, as we have seen above, the role of the inverse square law is merely instrumental in obtaining a Poisson equation. Given this goal, we may simply begin with a Poisson equation of motion. The Hamiltonian of an arbitrary system is given by

$$-\frac{\hbar^2}{2m}\nabla^2\psi + V\psi = E\psi, \tag{2.34}$$

where E is the eigen-energy of $\hat{H}$. By minimal substitution, μ has the form

(2.35) $$\boldsymbol{\mu} = -\nabla\Phi - \frac{1}{c}\frac{\partial \mathbf{A}}{\partial t}.$$

By comparing (2.34) with (2.11), I identify ρ and Φ as

(2.36) $$\rho \equiv \frac{i\sqrt{2m}(E-V)}{4\pi\hbar}\psi,$$

(2.37) $$\Phi \equiv \frac{-i\hbar}{\sqrt{2m}}\psi.$$

The reason for this particular arrangement is that we may obtain the correct unit for the stress energy tensor later. The vector potential **A** and the displacement current **J** can be decomposed into irrotational and solenoidal components, namely $\mathbf{A} = \mathbf{A}_i + \mathbf{A}_s$ and $\mathbf{J} = \mathbf{J}_i + \mathbf{J}_s$. With ρ and Φ defined, we can now derive $\mathbf{J}_i$ and $\mathbf{A}_i$. The Hamiltonian (2.34) is recast into a massen counterpart of the differential Gauss' law

(2.38) $$\nabla \cdot \boldsymbol{\mu} = 4\pi\rho.$$

The time-dependent Schrödinger equation

(2.39) $$i\hbar\frac{\partial\psi}{\partial t} = E\psi$$

can be used to derive an expression for $\nabla \cdot \mathbf{J}$. Differentiate (2.36) with respect to time and set it equal to $\nabla \cdot \mathbf{J}$ to obtain the continuity equation

(2.40) $$\nabla \cdot \mathbf{J} = \frac{\partial\rho}{\partial t} = \frac{\sqrt{2m}}{4\pi\hbar^2}\left(E^2 - EV + i\hbar\frac{\partial V}{\partial t}\right)\psi.$$

The energy field ε is given by

(2.41) $$\varepsilon = \nabla \times \mathbf{A}.$$

The divergence of the vector potential **A** can be derived by the Lorentz condition

(2.42) $$\nabla \cdot \mathbf{A} = -\frac{1}{c}\frac{\partial \Phi}{\partial t} = \frac{E}{c\sqrt{2m}}\psi.$$

Both equations (2.40) and (2.42) have the general form of a divergence

(2.43) $$\nabla \cdot \mathbf{S} = \phi.$$

To express **S** in terms of ϕ, we let $\mathbf{S} \equiv \nabla\sigma$. Then (2.43) is transformed into a Poisson equation

(2.44) $$\nabla^2 \sigma = \phi.$$

Solve σ in terms of ϕ. The vector potential **S** can then be obtained by taking gradient of σ, or $\mathbf{S} = \nabla\sigma$. The ∇ operator indicates that **S** is manifestly irrotational, i.e. $\nabla \times \mathbf{S} = 0$. By comparing (2.40), (2.42), (2.44) with (2.9), (2.10) and (2.11), we can derive $\mathbf{A}_i$ and $\mathbf{J}_i$ as

(2.45) $$\mathbf{A}_i = \frac{E}{4\pi c\sqrt{2m}} \nabla \int \frac{\psi(\mathbf{r}', t)}{|\mathbf{r} - \mathbf{r}'|} d^3 r',$$

(2.46) $$\mathbf{J}_i = \frac{\sqrt{2m}}{16\pi^2 \hbar^2} \nabla \int \frac{U(\mathbf{r}', t)\psi(\mathbf{r}', t)}{|\mathbf{r} - \mathbf{r}'|} d^3 r'$$

where $U(\mathbf{r}', t) \equiv EV(\mathbf{r}', t) - E^2 + i\hbar \frac{\partial V(\mathbf{r}', t)}{\partial t}$.

Once Φ, ρ, $\mathbf{A}_i$ and $\mathbf{J}_i$ are known, the massen equations are partially specified. Unfortunately the exact forms of $\mathbf{A}_s$ and $\mathbf{J}_s$ are hitherto uncertain. Nevertheless, we can still integrate the Schrödinger equation with Einstein field equation at least in principle. The massen equations can be expressed in covariant form

(2.47) $$\nabla^a F_{ab} = J_b$$

(2.48) $$\nabla_{[a} F_{bc]} = 0$$

where

(2.49) $$F_{\mu\nu} = \partial_\mu A_\nu - \partial_\nu A_\mu$$

and $A_\mu = (\Phi, \mathbf{A})$. The same stress tensor formulated for electromagnetism can be used for massen with minimal substitution[254]

(2.50) $$T_{\mu\nu} = F_{\mu\lambda} F_\nu{}^\lambda - \frac{1}{4} g_{\mu\nu} F_{\alpha\beta} F^{\alpha\beta}.$$

Through the massen stress tensor, we can integrate quantum mechanics with Einstein's field equation

(2.51) $$G_{ab} \equiv R_{ab} - \frac{1}{2} R g_{ab} = 8\pi T_{ab}.$$

Take of trace of (2.51), we have

(2.52) $$R = -8\pi T.$$

[254]Robert M. Wald, General Relativity (Chicago: Chicago, 1984), 70.

(2.53) $$R_{ab} = 8\pi\left(T_{ab} - \frac{1}{2} g_{ab} T \right),$$

where R_{ab} is the Ricci tensor which quantifies the curvature of spacetime and T is the trace of T_{ab}. Finally we have an unified mathematical formalism incorporating general relativity, quantum mechanics and electromagnetism.

The question invariably raised is: "Does the massen field have any physical content?" From (2.35) and (2.37), we can show that the mass field μ is proportional to momentum $\mathbf{p} = -i\hbar\nabla\psi$. According to Einstein's mass-energy equivalence, momentum is a measure of mass as in

(2.54) $$E^2 = m^2c^4 = \mathbf{p}^2c^2 + m_\circ{}^2c^4.$$

Hence, μ is not an empty concept. The elusiveness of $\mathbf{A}_s$ posts a mystery but does not in principle invalidate the scheme of the massen field. Nevertheless we need to specify $\mathbf{A}_s$ in order to define the energy field $\varepsilon = \nabla \times \mathbf{A}_s$. At this point, it is unclear to me if the massen force is a fundamental force of Nature or just a pseudo-force. The theoretical development of this new concept is still in its infancy. The answers to this and other questions are pending upon further considerations. In summary, I like to reiterate that, although the quantum mechanical massen field is not yet completely specified due to the

missing $\mathbf{A}_s$ and $\mathbf{J}_s$, quantum mechanics and general relativity are shown to be capable of being unified through the massen equations at least in principle.

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