ESCHATOLOGICAL IMPLICATIONS OF THE UNDERSTANDING
OF TIME AND SPACE IN THE THOUGHT OF ISAAC NEWTON

by

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TO

KATHLEEN AND MY PARENTS
ABSTRACT OF THESIS

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Title of Thesis: Eschatological Implications of the Understanding of Time and Space in the Thought of Isaac Newton

Chapter I is concerned with "Greek Concepts of Time and Space," treating the Presocratics, Plato's Timaeus and Aristotle's Physics. Chapter II provides "The Link Between the Greeks and Newton—Rene Descartes," focusing upon Descartes' Principles of Philosophy. Newton's "De Gravitatone et Aequponido Fluidorum" provides the link between Descartes and Newton in Chapter III, "The Influence of Newton's Theology on His Science." "De Gravitatone" is an early paper on the concept of space which eventually leads to Newton's Principia. Chapter IV treats "The Influence of Newton's Science on His Theology," beginning with a discussion of Newton's doctrine of the Church, then turning to Newton's understanding of the relation between biblical prophecy and history, and ending with an investigation of Newton's doctrine of the Second Coming of Christ, the relation between God, Space, the Temple of Solomon, and the Heavenly Mansions, and the relation between 'Time in Heaven' and 'Time in History.'

The concepts of time and space provide a common denominator between Newton's science and theology. In the long discussion concerning Newton's concept of "Absolute Space" historians of science such as E.A. Burtt, E. Mach, A. Koyrè and S. Toulmin have neglected the centrality of the concept of "place" in the development of Newton's concept of space and motion. "Place" is a particular volume occupied by a body; it is not the situation, situs, of a body. Here Newton follows Aristotle, but unlike Aristotle and Descartes, Newton holds a concept of mass so that through the equation relating density, mass and volume: \( d = \frac{m}{V} \), Newton is able to develop a duality between space (volume) and body (mass). Thus volumetric-space becomes for Newton something like Plato's "Receptacle" of the universe.

Newton in the General Scholium to the Principia states that space and time are attributes of God; Newton believes "Infinite Volume" is something like the biblical notion of "Spirit," and because of certain biblical passages, such as the one which suggests that in God we live and move and have our being (Acts 17:28), he then assumes that space is an infinite attribute of God. Central also to his concept of space is the passage "In my Father's house there are many mansions" (Jn 14:2) to which Newton refers in a footnote to the General Scholium. God's House may be the Temple of Solomon or the Universe—Newton believed the Temple was a microscopic model of the Universe. Thus Newton's attempt to reconstruct the Temple of Solomon, and his study of the Sacred Cubit, are all part of his understanding of the relation between God and Space. Time for Newton is linear, and there is no difference in quality between God's time and man's time, there is no difference between time and eternity—eternity is infinite time. History for Newton is mainly
chronology—one even suspects that history is mechanical.

Newton's historically-prophetic studies are related to his epistemological dualism between "Absolute" and "Relative" time and space in the introductory Scholium to the *Principia*. This Scholium says nothing about God; in the first edition Newton kept the science of the *Principia* separate from the theological aspects of this work. The difference between "Absolute" and "Relative" is the difference between "Theory" and "Observations," between "Mathematical Formula" (Books I and II of the *Principia*) and "Experimental Evidence" (Book III of the *Principia*). In his science Newton was strongly anti-metaphysical. He said, "hypotheses non fingo." He was equally anti-metaphysical in his theology. He said, "Religion and philosophy are to be preserved distinct." One school of thought has seen Newton as a religious "mystic" (E.N. Da C. Andrade, Lord Keynes), and another school has seen him as a religious "rationalist" (R.C. Westfall). But we suggest that he was something like an "empiricist" (although not in a strict sense of the word) in both his science and his theology. In his theology Newton developed an "empirical" proof for the existence and Providence of God. Newton studied biblical prophecy in the belief that it would be fulfilled in history. This fulfilment provided "verification" of the Christian religion. Just as Newton moved back and forth between "Mathematical Theory" and "Experimental Observation" in his science, so he developed a dialogue between "biblical prophecy" and "historical fulfilment" in his theology. "Prediction" was central to his idea of verification in both his science and his theology, and the Second Coming of Christ would be the Event above all others which would "prove" or "verify" the Christian religion.

Newton's doctrine of the Church may have had greater consequences for his science than has generally been recognized. Newton was what we call an "Anglo-Puritan," he held a Puritan view of history, but supported an Anglican church polity. At one point in history the earth was like the Garden of Eden before the Fall, but the minds of men became corrupted by idolatry. Just as the Jews were once pure and then became corrupted, so the Christian religion was pure, and then became corrupted with Constantine and Athanasius. And "philosophy" was once pure—as with Thales and the Pythagoreans—but it began to decline with Aristotle. In a footnote to his "General Scholium" Newton stresses that his concept of space goes back to the Presocratics. The geometry of Books I and II of the *Principia* his admiration for the Pythagoreans, and his Puritan doctrine of the church and of history seem intimately related.
TABLE OF CONTENTS

PREFACE ................................................................................. 1

INTRODUCTION ..................................................................... 1

Chapter

I. GREEK CONCEPTS OF TIME AND SPACE ...................... 6
   A. Presocratic Background ............................................ 6
   B. Plato's Space and Time in the 'Timaeus' ....................... 12
      1. Plato's Concepts of Space—Volumetric
         and Relational .................................................. 15
         a. Plato's Volumetric Space—The Receptacle .......... 15
         b. Plato's Relational Space—The Triangles .......... 23
      2. Plato's Time—Related to Eternity, Number
         and the Universe .............................................. 28
      3. Plato's Space, Time and Experience—The
         Circular Fluxion of a Point-Soul ......................... 34
   C. Aristotle's Space and Time in the 'Physica' ................. 47
      1. Preliminary Concepts Necessary to an Under¬
         standing of Aristotle's Space and Time ............... 48
      2. Aristotle's Concept of Space as Plato—at
         Once Volumetric and Relational ......................... 51
      3. Aristotle's Concept of Time—the Number
         Produced by a Moving Now-Point ....................... 60
   D. Eschatological Questions Derived from Greek
      Space and Time .................................................. 71

II. THE LINK BETWEEN THE GREEKS AND NEWTON—RENE DESCARTES .. 77
   A. Introduction—The Link Between Aristotle and
      Descartes .................................................................. 77
   B. Descartes' 'Principles of Philosophy'—Rationalism ... 90
      1. Descartes' Epistemological Metaphysics—Cogito .. 90
      2. Descartes' Identity of Space and Body—
         Extension ......................................................... 101
      3. Descartes' Cosmological Synthesis—Vortices ....... 106
   C. Observations Concerning Descartes' Philosophy ....... 110
III. THE INFLUENCE OF NEWTON'S THEOLOGY ON HIS SCIENCE

A. Introduction—Isaac Newton: Mystic, Rationalist or Empiricist? .......................... 120
1. Was Newton a Religious "Mystic"? ................................................................. 124
2. Was Newton a Religious "Rationalist"? ............................................................. 133
3. Was Newton a Religious "Empiricist"? ............................................................... 137

B. The Background to Newton's Scientific Work .................................................. 150
2. Isaac Barrow and Newton's Mathematical Education—Mathematical Formula ......... 154
3. Robert Boyle and Newton's "Experimental" Education—Empirical Verification ......... 162
4. René Descartes and the Cosmological Synthesis ............................................ 166
5. Eschatology, Time and Space in Newton's Science ........................................ 167

C. Newton's Ontological Dualism Between Space (Volume) and Body (Mass) .............. 171
1. Newton's "De Gravitatione"—His Early Ontology ............................................. 172
2. Newton's Unified Ontology—the General Scholium to the 'Principia' ................. 202

D. The Epistemological Dualism Between Absolute and Relative ............................ 210

IV. THE INFLUENCE OF NEWTON'S SCIENCE ON HIS THEOLOGY

A. Newton's Doctrine of the Church—"First Principles" Derived from Scriptures ......... 248
1. Newton's Doctrine of the Church—Falkland and Mede ..................................... 253
   a. Falkland—Roman Catholic "Infallibility" vs. Protestant Scripture .................. 254
   b. Mede—"Fundamentals" and the Church in History ........................................ 268
2. Newton's Doctrine of the Church—His Anglo-Puritanism ................................ 272
3. Newtonian vs. Unitarian Doctrine of the Church ......................................... 282

B. Newton's Empirical Evidence for the Existence of God .................................... 290
1. The Concept of Theological Empiricism Applied to Christianity .......................... 291
2. Biblical Prophecy and History—Eschatological Verification ............................. 294
   a. Newton's Anglo-Puritan Interpretation of History ...................................... 294
b. The Context and Significance of Newton's Historico-Prophetic Work 310

c. Emanuel's Evaluation of Newton as a Historian 314

d. An Outline of Newton's Approach to Historico-Prophetic Theology 318

C. Newton's View of Space and Time as Related to Biblical Eschatology 328

1. Newton's Eschatology: The Centrality of the Second Coming of Christ 330

2. Space and Eschatology in Newton—Heavenly Mansions 337

3. Time and Eschatology in Newton—Linear Time in Heaven and History 347

CONCLUSIONS AND OBSERVATIONS 358

BIBLIOGRAPHY 368
There are some general comments which I will make about this study. Newton's theological manuscripts were sold by Sotheby and Company in 1936, and although Lord Keynes gave a fair collection of the theological manuscripts to King's College, Cambridge, to which I have fortunately had access, nevertheless there are numerous manuscripts listed in the Sotheby Catalogue which I have been unable to locate. I wrote to Sotheby and Company, and received a list of the names and addresses of those who purchased manuscripts at the 1936 sale; unfortunately many of the buyers have since deceased, which makes the task of locating the missing manuscripts more difficult. Although I did obtain some leads on manuscripts from Dr. J. Schwartz of Sussex, none of his suggestions bore fruit. I printed the following advertisement on page one, column three, in the 1 January 1966 issue of the London Times: "Must locate Isaac Newton's Theological MSS--Write B. Downing, 10 Moat Terrace, Edinburgh, 11." I have as yet received no response to this announcement.

One of the manuscripts which would have been very useful for my study was listed as Sotheby Lot No. 243. This manuscript was purchased by Mr. L. Robinson, London, and from Mr. Robinson I learned that the manuscript was consequently sold to a Mr. H.J. Hall in New York City (address unknown), who has since died. I then placed the following advertisement on page fifty nine, column two, of the
9 January 1966 edition of the New York Times: "Must find Isaac Newton's manuscript on 'Prophecies Concerning Christ's 2nd Coming', purchased in 1956 by Hiram J. Halle, E. Downing, 10 Moat Terrace, Edinburgh, 11, Scotland." I have as yet received no reply to this advertisement, and do not know the location of this manuscript. To my knowledge the King's College, Cambridge, and the Babson Institute, Massachusetts, contain the only two major collections of Newton's manuscripts which contain important theological works. Frank Manuel in his work, Isaac Newton: Historian, has made a thorough study of Newton's historical manuscripts, particularly the ones in King's College, Cambridge, the Babson Institute, and the Bodleian Library, Oxford. While the lack of some of Newton's theological manuscripts has made my study difficult, it has not made it impossible. With the materials that are available I believe that a fairly clear picture of the "eschatological implications of the understanding of time and space" emerges from Newton's science and theology.

The difficulty presented by Newton's scientific manuscripts is of another kind. Before 1962 there had been relatively little attention paid to the relation between Descartes and Newton by historians of science. Then in 1962 A. Rupert Hall and Marie Boas Hall published a work entitled Unpublished Scientific Papers of Isaac Newton: A Selection From the Portsmouth Collection in the University Library, Cambridge, a work which included a manuscript by Newton entitled "De Gravitatione et Aequipondio Fluidorum." This manuscript clearly demonstrated the fact that in his early years as a Cambridge student Newton fought with and rejected Descartes' concept of space; this work perhaps represents
the turning point between Descartes' *Principia* and Newton's *Principia*. My study began with the Presocratic, Platonic and Aristotelian concepts of time and space, and then moved from Aristotle to Descartes, and then from Descartes to Newton on the basis of Newton's "De Gravitatione."

As I was completing my research Alexandre Koyré published his *Newtonian Studies*, and John Herivel published *The Background to Newton's Principia*, both of which pay particular attention to the influence of Descartes on Newton. Thus the field of the history of science in relation to Newtonian scholarship is in a state of flux. New material is being published constantly, which makes this aspect of my study more difficult. I understand that I. B. Cohen and others are working to publish a critical edition of Newton's *Principia*, which would have helped this study had it been available. I have been unable to give the recent material by Koyré and Herivel the attention which it deserves, although such further attention as their work might have received would not have radically altered my conclusions. On the one hand while there is a flood of material being prepared by the historians of science in relation to Newton, on the other hand there is at present no definitive study of Newton's theology, and my study does not attempt to deal with Newton's theology in general, but rather with the eschatological aspects of his theology. In order to keep a balance between the scientific and theological aspects of my work, I have been forced to ignore much of the material relating to Newton's scientific work. These preliminary remarks have been made in order to give a broader perspective on some of the tensions which will be apparent in this study.
I want to express my thanks and appreciation to my advisors Professor John McIntyre and Professor Thomas F. Torrance of the University of Edinburgh, New College, without whose guidance I would not have undertaken this study, and whose broad knowledge of the field of scholarship has given me a valuable background through which I could see more clearly the problems involved in this paper. I only hope this work begins to approach a standard which is worthy of the attention and care which they have given it.

I am deeply indebted to the University of Edinburgh Grants Committee for their award of a University Junior Fellowship, and to the Higgins Scholarship Foundation of Chicago, without whose financial assistance this work could not have been completed.

My appreciation must also be expressed to the library staffs of the University of Edinburgh, New College, Edinburgh, the National Library of Scotland, and the University of Cambridge. I am especially indebted for the way in which Newton's material was readily made available to me at King's College during my stay in Cambridge.

Finally I must express my gratitude to Miss Mary Naughton, Miss Kathleen Dickie, Miss Jean Allan, Miss Christine Carey, Miss Margaret Scott, and Mrs. Judith Stoothoff, for their assistance in the typing of the manuscript. Perhaps I am most indebted to my parents who started me on my academic work, and to my wife, without whose support this study would not have been either undertaken or completed.

B.H.D.
ESCHATOLOGICAL IMPLICATIONS OF THE UNDERSTANDING
OF TIME AND SPACE IN THE THOUGHT OF ISAAC NEWTON

Introduction

The first two chapters of this paper will attempt to suggest some of the philosophical, cosmological, scientific, historical and theological developments which preceded and anticipated the work of Isaac Newton. We will focus especially on the Presocratic, Platonic, Aristotelian and Cartesian concepts of space and time which provided much of the immediate philosophical background to Newton's thought. When we come to Newton himself we will find that to a certain extent Newton attempts to develop "empirical" concepts of time and space, as opposed to the more "rational" concepts developed by the Greeks and Cartesian. When we examine Newton's theology we shall see how fundamental to Newton's perspective is his Protestant doctrine of the church; he holds what we will call an "Anglo-Puritan" doctrine of the church and view of history, and this Puritanism influenced both his theology and his science. What we will in fact come to suggest is that Newton's theological personality in general can best be described as being that of a "Protestant empiricist," although we will not use the term "empiricist" in a radical sense.¹

This larger question of Newton's scientific and theological personality will be raised as we examine the eschatological implications of Newton's understanding of time and space. A basic presupposition of this paper is that eschatology, Christian eschatology to be specific, is a subject which

¹Cf. above, general introduction to Newton, Chapt. III, pp. 120 ff.
we understand theologically and biblically as an end or a consummation which is somehow related to time and space. In view of this relationship, we are concerned to what extent our understanding of Christian eschatology has been influenced by concepts of time and space whose derivation and definition has been other than biblical. We have found that investigating these concepts in relation to Newton has thrown a considerable amount of light on the relation between Newton's scientific and theological method and conclusions. A study of eschatology, time and space offers a good avenue to both epistemological and ontological problems in Newton's scientific and theological work. Although science and theology are basically separate disciplines for Newton, we shall find that his concepts of time and space are common denominators in each of these disciplines.

Our course will be to investigate in Chapter I Greek concepts of time and space, focusing on the Timeus of Plato and the Physics of Aristotle. Then we shall briefly mention the link between Aristotle and Descartes' Principia Philosophiae, and having pointed to the link we will then devote the major part of Chapter II to a discussion of Cartesian concepts of space. Descartes' Principia offers the immediate background for Chapter III in which we will investigate the scientific concepts of time and space in Newton's Philosophiae Naturalis Principia Mathematica. Finally in Chapter IV we will investigate the role of eschatology, time and space in Newton's theology. Other men could have been chosen for this study such as Plato,\(^1\) Augustine,\(^2\)

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\(^1\) Plato's Timeus will of course be examined below.

\(^2\) Augustine's Confessions and City of God can both be examined in terms of space and time; cf. especially Confessions, Chapter XI.
Kant or Einstein, but Newton offered what seemed to be the best alternative for the following reasons. a) The seventeenth century is a period in the history of the development of science and philosophy during which there was an active dialogue between the philosopher-scientists (natural philosophers) and the theologians. In fact, natural philosophers were often also theologians, and vice-versa, as was Newton. b) Newton lived and wrote during what has been called a pivotal century in thought, the seventeenth. c) Pertinent also is the consideration that as the schools of philosophy and physics became historically separated in the nature of their disciplines,

1. Christopher B. Garnett, Jr., The Kantian Philosophy of Space (New York: Columbia University Press, 1939), has treated the spatial aspects of Kant, beginning with the background of the work of Leibniz and Newton. In making our reference we will be following the form generally suggested by Kate L. Turabian in the work, A Manual for Writers of Term Papers, Theses, and Dissertations (Chicago: The University of Chicago Press, 1955). At those points where Turabian is not specific, we shall simply attempt to adopt a consistent means of annotation. After our first citation of a major work, such as that by Garnett, we will hereafter refer to it as Garnett, Kantian, followed by page reference. We will follow the name of the author with either the first word, or with what seem to be key words in the title, to make the reference clearer.


3. Basil Willey has observed that "The Cambridge Platonists are the modern analogues of the Alexandrian Fathers, Clement and Origen, with this significant difference—that the Fathers came between a declining philosophy and a rising Christianity, while the seventeenth century theologians came between a declining Christianity and a rising philosophy. The resemblance between the two schools lies in their effort to maintain religion and philosophy as allies, not as strangers or enemies" (Basil Willey, The Seventeenth Century Background: Studies in the Age in Relation to Poetry and Religion (London: Chatto & Windus, 1934), p. 120).

Newton has been relegated to the scientific camp whereas his opponents René Descartes and G.W. Leibniz have been remembered chiefly as philosophers. Especially important for our consideration is the fact that Newton and the "rationalists" held to some extent opposing views of the nature of time and space, Newton developing his physics on the basis of what he called "absolute" time and space,¹ while Descartes and Leibniz upheld what we have come to call a "relative" interpretation of time and space.² In broad terms one can say that it has been between these absolute and relative views that most scientific and philosophic thought has moved from the seventeenth century up to the present time,³ these two positions having been brought together by Kant in his Critique of Pure Reason as he attempted to reconcile the a priori with empirical knowledge.⁴


² With some reservation Carr says of Leibniz, "it is certainly arguable that the facts on which the modern principle of relativity is founded are rationalized by his metaphysical principles." Herbert W. Carr, Leibniz (London: Ernest Benn Limited, 1929), from the series Leaders in Philosophy, p. 210.

³ A possible exception to this category of interpretation might be a "subjective" or "experiential" view of time such as Henri Bergson has developed in Time and Free Will: an Essay on the Immediate Data of Consciousness, Trans. F.L. Pogson, (London: Swan Sonnenschein & Co., Lim, 1910); Bergson is not unaware of the scientific aspects of time, see his discussion of duration, contingency and prediction, pp. 172-199.

How these views of time and space have affected thinking in relation to Christian eschatology it is our intention to demonstrate. We are not suggesting that eschatology is the only aspect of the interpretation of the Christian faith which has been affected by the concepts of time and space. But we do believe that eschatology is a subject which will bear fruitful analysis.

Our first chapter deals with the development of Greek philosophy of time and space in Plato and Aristotle preceded by some mention of Presocratic background. To be exhaustive in our treatment of Greek thought is out of the question. On the other hand, we are not attempting a sketch or summary of the Greek view of space and time. Rather we are focusing upon some of the types of thought which will again confront us in Newton and rationalists such as Descartes and Leibniz. One might suppose that we ought to devote as much attention to many of the men between Newton and Descartes as we do in introducing Plato and Aristotle, but we will not. Our strong concern for Plato and Aristotle is that to some extent they are the prototype of Newton and the rationalists. This preliminary conclusion will not hold in every test case, but we suggest that Newton was first influenced by the tradition of Plato, but perhaps ended as an Aristotelian, whereas Descartes and Leibniz were more closely allied with Aristotle as the foundation of their Scholastic education, and later turned to Plato. Whatever the actual interaction, Plato and Aristotle as a philosophical and scientific school represent the tradition from which Newton and the rationalists derived most of their knowledge about time and space.

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CHAPTER I
GREEK CONCEPTS OF TIME AND SPACE

Introduction

We shall approach this chapter with regard to four main subjects:
A) The Presocratic Background, B) Plato's Space and Time in the Timaeus,
C) Aristotle's Space and Time in the Physics, and D) Eschatological Questions
Derived from Greek Space and Time. We are not suggesting that Plato's
Timaeus and Aristotle's Physics are the only sources which could be stud¬
ied, but they do offer a systematic and succinct account of Plato's and
Aristotle's view of time and space.

A) Presocratic Background

Tradition alone suggests that a paper such as this one should begin
with a review of Greek philosophic thought. But aside from tradition,
investigation suggests that the technique of interpreting space and the
physical universe geometrically was being developed by Thales as early as
the sixth century B.C.¹ On the one hand the geometrical interpretation of

¹J.O. Urmson (ed.), The Concise Encyclopaedia of Western Philosophy
and Philosophers (London: Hutchinson & Co. Ltd., 1960), p. 377. See also
Presocratics and the Pythagoreans (Vol. I-II, Cambridge: Cambridge
University Press, 1962-1965), pp. 52-54; Guthrie has reservations about
the extent to which Thales actually developed geometrical propositions,
but says that here undoubtedly the Greek "talent for generalization, for
extraction of the universal law from the particular instances" was
beginning to develop (p. 54). Cajori claims that some of Thales' mathematical ideas were gleaned from the Egyptians; Florian Cajori,
Cajori also suggests that Egyptian mathematical manuscripts may date back
as far as 3400 B.C. (p. 11). "To Egypt Greece is indebted, among other
things, for its elementary geometry" (p. 16).
space is an integral aspect of Newton's Philosophia Naturalis Principia Mathematica (1687), and thus reflects indebtedness to a scientific technique (as well as a philosophic conclusion about the nature of space) which had been developing for a period of more than two thousand years. On the other hand we believe that the res cogitans and res extensa of Descartes, and the "Monads" of Leibniz owe much to the definition of a geometric point.

It is dangerous to point with confidence to the birth of Greek philosophy, but Burnet begins with Thales, the first of the Milesian philosophers. Difficult as it is to determine exactly what Thales thought and taught, since he left no written records, yet through secondary references, apparently at least two important modes of thought were developing under Thales' influence. Thales "introduced geometry into Greece."

---7---


2 Gottfried Wilhelm Leibniz, The Monadology and Other Philosophical Writings, Trans. Robert Latta (Oxford: At the Clarendon Press; 1898), pp. 215 ff.; Leibniz says "The Monad, of which we shall here speak, is nothing but a simple substance, which enters into compounds. By 'simple' is meant 'without parts;" (p. 217).


4 Greek philosophers such as Herodotus and Aristotle frequently refer in their writings to Thales (Ibid., pp. 18-21).
and taught that "water" is the origin ( ὕδωρ ) of all things. Geometry early became one of the cornerstones of Greek philosophy, upon which the later Platonic school would build. Geometry set the pattern for the Greek practice of extracting "the 'form' from the 'matter'," by offering an abstract, unchanging and rational means of examining spatial relations.

The hypothesis attributed to Thales that water was the arche of all things is important to us for two reasons. (1) In raising such an hypothesis "Henceforth the question whether everything can be regarded as a single reality in different forms is the central one of Greek science." (2) The hypothesis also points to a developing cleavage between natural philosophy and theological myth. The relation between myth and science has been and continues to be perplexing. Cosmology is especially an area

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3 Ibid., pp. 54-58; arche is interpreted by Aristotle as principle or cause (p. 63).

4 In speaking of Thales Jaeger says, "But his view of the origin of things brings him very close to the theological creation-myths, or rather leads him to compete with them. For while his theory seems to be purely physical, he evidently thinks of it as also having what we may call a metaphysical character" (Jaeger, Theology, p. 21). The view that water is the underlying substance of the universe has parallels with the Hebrew account of creation in Genesis 1:1-6 which suggests that the heavens are filled with water, and thus the firmament was needed to "separate the waters from the waters" (Gen. 1:6); we shall cite in this paper from the Revised Standard Version of the Bible (New York: Thomas Nelson & Sons, 1952), unless otherwise noted.
in which it is still often difficult to distinguish between a scientific "model" or "theory" and a theological "model" or "myth." The relation of myth to the natural philosophy of Thales is especially important in reference to creation and the arche behind the universe. Eschatology is sometimes interpreted as an inversion of creation, and as such is affected by the creation myths.

Greek philosophy moves from Thales to Anaximander and then to Anaximenes, the third of the Milesian philosophers. The pattern of thought, interest in geometry and astronomy, combined with a heterogeneous mixture of science, philosophy and myth followed the methodology established by Thales. One significant deviation from Thales was the view that "air" was the arche of the universe, and here with Anaximander began the "aether" theory which was not demonstrated to be impossible until the late nineteenth century. Men believed that the air we breathe into our soul encompasses the world and all of space. Here one recognizes the parallel with the Hebrew idea of נַחַל, and one also sees how as the "four-elements" view of matter—water, fire, air, and earth—developed, air was related to man's soul, and death became the vehicle by which man's soul was set free either to be reincarnated or...

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2 Burnet, Thales, pp. 24-25. 

3 Ibid., p. 25


5 Cf. Gen. 1:2; also "God formed man of dust from the ground, and breathed into his nostrils the breath of life" (Gen. 2:7).
to return to the vast reaches of air in space.¹

Another main stream of Presocratic thought was that of the Pythagorean school of Italy which influenced Socrates, Plato’s master.² Although it is extremely difficult to assess the exact nature of the contribution which the Pythagorean school made to the history of thought,³ we can summarily say that the school was interested in scientific and religious thought, and often combined the two enterprises.⁴

The world view of the Pythagoreans was built around geometry, which Burnet believes was developed on the foundation laid by the Mileto school;

The importance of the infinite (τὸ ἄπειρον) in the Pythagorean cosmology suggests Milesian influence, and the identification of the infinite with 'air' by at least some Pythagoreans points to a connexion with the doctrines of Anaximenes.⁵

Pythagoras and his school discovered the numerical basis of the musical scale;⁶ the four basic "elements" of matter were postulated to have one of five possible geometrical forms;⁷ the relation between numbers and geometry was developed;⁸ eventually the doctrine was postulated that "all things are

---10---


³The Chief road block to a historical study of the Pythagoreans is their cultic practice of guarded secrecy over religious and scientific knowledge; cf. Guthrie, Presocratics, pp. 146-156.

⁴Pythagoras is "the man who first united science with religion" (Burnet, Thales, p. 36).

⁵Ibid., pp. 39-40. ⁶Ibid., p. 45.


⁸Burnet, Thales, pp. 51-56.
numbers;"1 as a synthesis of these concepts, astronomy was studied in terms of geometry, order and number.2 It was the union of the view of the orderly, geometrical and mathematical nature of astronomy with the numerical basis of music which led to the post-Pythagorean doctrine which has been called "the harmony of the spheres."3 Music was one aspect of the development of the general numerical concept of the "Limited" and the "Unlimited,"4 a concept which supplemented the Milesian view of "matter" with "the correlative conception of 'form'."5 Applied in such a way as to identify air with the void we have the beginning of "the conception of abstract space or extension, and what chiefly interested Pythagoras, so far as we can see, was the problem of how it became limited so as to present the appearance of the world we know."6

Epistemological theories were combined into a numerical mysticism joining number, music and soul, "Since music was held to have special power over the soul, which permeated the cosmos, the whole world must be

---11---

1 Ibid., p. 52
2 Guthrie, Presocratics, pp. 207 ff.
3 Burnet, Thales, p. 56.
4 Ibid., pp. 44-49; cf. also Guthrie, Presocratics, pp. 207 ff.
5 Burnet, Thales, p. 44.
6 Ibid., p. 51; Michael Polanyi in his work, Personal Knowledge: Towards a Post-Critical Philosophy (London: Routledge & Kegan Paul, 1958), has shown that the Pythagorean geometry made a great contribution to "The Growth of Mechanism" in the seventeenth century (pp. 6-8). We shall see that Newton admired the Presocratics, and their view of "space" in particular.
somehow made out of number. They (including men and animals) were seen to have a basic unity in number which promoted the Pythagorean doctrine of the "transmigration" and "reincarnation" of the soul, a doctrine shared with the sixth century Orphics.

The combination of mathematics and physical science has had broad implications; thus the concepts of space and time came to be treated geometrically and mathematically, fully in evidence of Plato's Timaeus although modified in Aristotle's Physics. The Pythagorean relation between the circle and perfection was assumed by some men as late as Kepler. This metaphysics of the circle contributed to the Greek view that the perfect form of time was like a circle; time was to an extent a product of an ordered, cyclical universe; the pre-creative state of the cosmos, in the words of Plutarch, offered the "raw material" of time. Undoubtedly other basic contributions to the concepts of time and space are to be found in the work of the Pythagorean school, but we shall let Plato develop them.

B) Plato's Space and Time in the 'Timaeus'

Before examining the work of Plato we shall mention something of the

---12---

1. Urmson, Western Philosophy, p. 338.
2. Reincarnation was of course closely related to a cyclical view of time.
3. Jaeger, Theology, p. 83
4. Guthrie is convinced that the marriage of mathematics and physical science changed the course of history, Guthrie, Presocratics, p. 238. Throughout this study there will be an underlying interest in the relation between knowledge and history.
5. Ibid., p. 339.
influence of Socrates on his pupil Plato. With Socrates Greek philosophy is firmly established in Athens, and he is the first philosopher in a series which moves to his pupil Plato, and then succeeds to Aristotle, the pupil of Plato. What we know concerning Socrates we must for the most part receive from Plato in whose dialogues Socrates is often a chief speaker.¹ Socrates had a greater influence on the humanistic thought of Plato than on his scientific thought, because Socrates was especially interested in "the relation between sensation, belief, and knowledge,"² setting the stage for Plato’s epistemology. Nevertheless, Socrates’ "Cathartic Method" of division gave Plato a scientific methodology which was applied in the Academy,³ and later adopted by Aristotle. The method suggested that a thing may be known by the sum of its parts, or by the total of its subdivisions.⁴ Perhaps our chief interest in Socrates should be that he was a "philosophical sceptic" of a kind, who had one question foremost in his mind, and that was "why things are what they are and become what they become."⁵ This is the question of underlying cause, a question Plato answered in terms of the

¹Burnet, Thales, pp. 126 ff.

²Ibid., p. 133.


⁴To some extent the Parmenides dialogue of Plato on the "One" is representative of the difficulty in viewing the whole as the sum of its parts. But this methodology of division is characteristic of science, philosophy and language; cf. Daniel Lerner (ed.), Parts and Wholes (New York: The Free Press of Glencoe, 1963).

⁵Burnet, Thales, p. 133.
duality of Being and Becoming; this question has within it the concept of cause and effect, a concept later pursued to its limit by Aristotle in his four categories of causes.

We should add that Socrates was "a firm believer in the immortality of the soul and in the life to come" and he often "related eschatological myths in the Orphic style." From Socrates Plato undoubtedly gained the greater part of his formal education, and this education together with Plato's travels accounts for the influence of Greek men of letters such as Empedocles on the cosmology of Plato.²

Most of our knowledge of Plato's cosmology is developed or summarized in the Timaeus, a dialogue probably named for an Italian Pythagorean.³ The exact method by which the Timaeus should be analysed is not apparent. Scholars such as Cornford and Taylor agree that Plato is offering to some extent an inherited cosmology. Furthermore, much of the material presented is in a "mythical" or "poetic" form, and a literal treatment of the work is hazardous. We cannot decide here what Plato intended as "pure science" and what was intended allegorically. We shall be satisfied to examine a few of the ideas within the material, whether or not they represent Plato's intended interpretation. Perhaps a "literal" translation most truly represents the way in which Aristotle interpreted Timaeus, as well as the most likely method for understanding the text.

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of interpretation employed by Newton or Leibniz. We shall first treat briefly Plato's concept of "physical" space, followed by an exposition of his idea of time, and concluding with a discussion of the relation of time and space to experience or the soul.

1) Plato's Concept of Space—Volumetric and Relational

a) Plato's Volumetric Space—The Receptacle

Plato's concept of physical space is parallel in many ways to the concept of Newton and Leibniz.\(^1\) Reality, Plato believed, can be classified under three categories: Being, Space and Becoming.\(^2\) It is significant that space is not mentioned specifically until 52A of the *Timaeus*, whereas the concept is introduced in section 49A when Plato speaks of "the Receptacle—as it were, the nurse—of all becoming."\(^3\) The need for the Receptacle is an integral part of Plato's epistemology. He sees knowledge of the real as consisting of first Forms, the eternal order. Second are the stimuli

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\(^1\) According to Taylor Plato's 'timeless space' 'is what Newton called 'absolute' time and mathematical space, and what Leibniz had equally in view when he defined space as the order of co-existences' [A.E. Taylor, *A Commentary on Plato's Timaeus* (Oxford: At the Clarendon Press, 1928), p. 350]. Later we shall look more closely at the differences between the absolute time and space of Newton and the relative time and space of the rationalists Descartes and Leibniz. Geometry, however, was the common ground between Newton and Leibniz. Time and space were perhaps more "intelligible" for Leibniz than for Plato; cf. Schrecker, "Leibniz and the Timaeus," p. 501.

\(^2\) *Timaeus*, 52A and B.

\(^3\) Ibid., 49A; Plato has many synonyms for his technical term "Receptacle" (σποδός); matrix (ἐγκυμνών), mother (μητρός), nurse (τιθηρυ), and later (52A) space or room (χώρα).
behind our "sense data," the world of constant flux which is always "Becoming." Becoming is what we call the created world, the object of study of empirical science. Becoming is most clearly expressed as qualities analogous to the shadow of Plato's cave. Third is Space, the reflector of the shadow, that "in which" changing qualities are reflected, as fleeting images are seen in a mirror. Plato speaks of the Receptacle as the "nurse" of Becoming. One ancient view held that the role of the mother in birth was passive. The father (Being, Form) planted the seed in the mother (Receptacle, Space) resulting in the child (Becoming, Physical Reality). As the mother was understood only as a place for the child to grow, and not as actually contributing to the form or quality of the child, so space was the passive place of Becoming. "Plato's point" according to Cornford, is that the Receptacle has no inherent sensible qualities of its own, and to

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1 Taylor, Commentary, p. 351.

2 The created world is for Plato the "best of all possible worlds" (Ibid., p. 297); cf. Timeaus, 29D-300; this concept of the best of all possible worlds was later expanded by Leibniz.

3 Plato emphasizes the fact that we have extreme difficulty in pointing to the changing elements in the world. "Whenever we see a thing perpetually changing—fire, for example—in every case we should speak of fire, not as 'this', but as 'what is of such and such a quality'," Timaeus, 49D; cf. Norman Gulley, "Interpretation of Plato, 'Timaeus' 49 D-E," American Journal of Philology, Vol. 81 pp. 53-64.

4 Cornford, Commentary, p. 181.

5 Ibid., p. 185; cf. Timaeus, 50D.

6 Taylor comments that "this is space conceived more geometrically," Taylor, Commentary, p. 312.

7 Cornford, Commentary, p. 188.
this extent parallels mathematics which investigates the middle ground between forms and sensible objects.\textsuperscript{1}

Beginning with \textit{51E} Plato again lists the three constituents of his universe.\textsuperscript{2} "Third is Space, which is everlasting, not admitting destruction; providing a situation for all things that come into being, but itself apprehended without the senses by a sort of bastard reasoning, and hardly an object of belief."\textsuperscript{3} Space (\(\chi\omega\rho\alpha\)) is here named for the first time rather than its equivalent Receptacle. Space is "everlasting" and "not admitting destruction" which distinguishes it from Time.\textsuperscript{4} Plato's space has many of the properties of Newton's absolute space which could not be destroyed because its existence was the product of the Infinite nature of God.\textsuperscript{5}


\textsuperscript{2}One of the underlying problems of Plato's epistemology is his "separation" (\(\chi\omega\rho\iota\sigma\mu\alpha\)\(\xi\)) of the Eternal from the Temporal, of Being from Becoming. Thus Plato's theory of knowledge has been called "dualistic," but in the light of the three constituents of Being, Space and Becoming, "dualistic" is something of a misnomer. Aristotle criticized Plato's "separation," but his "order of being" does not satisfactorily resolve the difficulty. The basic problem of Plato's separation is that "(a) The Forms cannot cause motion in objects if separate from them. (b) They cannot give \(\varepsilon\\sigma\delta\iota\alpha\) to objects if separate from them. (c) They cannot make objects intelligible if separate from them," J.D. Mabbott, "Aristotle and the \(\chi\omega\rho\iota\sigma\mu\alpha\) of Plato," \textit{Classical Quarterly}, Vol. 20, p. 73.

\textsuperscript{3}Timaeus, 52B.

\textsuperscript{4}Cornford made the following observation: "Space is thus essentially different from Time, which was ranked among the works of intelligence and had an archetype, eternal duration, of which it was an image. There is no archetype of Space, which exists in its own right as surely as does the Form" (Cornford, \textit{Commentary}, p. 193).

\textsuperscript{5}Newton, \textit{Principia}, the "General Scholium," p. 545.
Space provides "a situation for all things that come into being," we might say a container for the sense data. Plato's epistemological comment that space is "apprehended without the senses by a sort of bastard reasoning" stands in opposition to those who believe that space can be apprehended either rationally, or by the senses (either by sight or by touch), or both, as with Kant.\(^1\) Plato thus contrasts space both with Being which is pure rationality and with Becoming which is apprehended through the senses.

We have been speaking about physical space in the sense that it is the container of the universe. Burnet states that "the so-called 'primary matter' of the Timaeus is space of three dimensions" and that "the 'elements' of the corporeal are completely accounted for by the regular solids, and they in turn can be constructed from the elementary triangles."\(^2\)

This statement by Burnet illustrates the logical sequence of Plato's development of the idea of space, for the Timaeus moves from the universal Receptacle to the particular "spaces" occupied by "solids" composed of triangles. Since the Receptacle is volumetric, it has the potential of holding three-dimensional mass. By speaking about the space of "primary matter" (Aristotle's basic substance), about regular solids and about triangles, Burnet has pointed to one of the difficulties in speaking about space. We speak about empty abstracted physical space, about the space occupied by a three-dimensional solid, the area of space which a two-dimensional rectangle represents, and we also speak about the spatial length of a one

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\(^1\) Schröer, "Kant's Space and Time," pp. 510-11.

\(^2\) Burnet, Thales, p. 344.
dimensional line. A set of terms is needed to distinguish between different uses of the word space, and we propose to suggest a technical term to represent the idea of Plato's Receptacle, and Newton's Absolute Space in contrast to the space of relationships between sensibles, solids, triangles, lines and points. We propose to use the term **Volumetric Space** when referring to universal, homogeneous, physical space. We shall contrast Volumetric Space with Relational Space, the aspect of space which causes us to believe entities within Volumetric Space are separated, or related, or united.¹

It would seem that there are at least two aspects of space which are primary, and to quite an extent inseparable. They are that (a) Space offers the situation in which events occur, it is one aspect of reality which enables us to distinguish between two of Whitehead's "event-particles,"² it is the context of experience, the context and linguistic basis of I-Thou, I-It

¹We are using the concept of "Volume" as it is generally applied in physics, which is defined practically as "The cubic centimeter, the volume of a cube whose edges are one centimeter in length. . . . Dimension, 
²Alfred N. Whitehead, *Concept of Nature* (Cambridge: At the University Press, 1920), pp. 86, 93-94; he says, "We ultimately want to arrive at the timeless space of physical science, and also of common thought which is now tinged with the concepts of science. It will be convenient to reserve the term 'point' for these spaces when we get to them. I will therefore use the name 'event particles' for the ideal minimum limits of events" (p.86).
relations; it is space that separates and joins persons as well as particles; it is Relational Space. (b) Space also has a character which we can call Volumetric. Whether or not this term can further be defined is difficult to say. It becomes less intelligible when we try to apply a mathematical definition of space to physical space.\(^1\) The word "volumetric" is not meant to imply any particular notion of the ultimate shape of physical space, but rather that volume is independent of shape.\(^2\) Although it might be preferable to avoid any geometric term, the volumetric aspect of space seems to represent essentially what Plato intended by his idea of the Receptacle; that is, whatever else is characteristic of space, it seems

\(^1\) The difficulty is that as soon as we say, "space is three dimensional," we have imposed a certain geometrical form on physical space which we do not actually find in nature. To locate an "event particle" in the space-time continuum of relativity theory requires not only reference values for three dimensional space, but also a time value, so that the "relative" and "volumetric" aspects of space are intimately related.

\(^2\) Plato definitely believed that space could be separated from body and matter, and maintain an independent existence, although Aristotle could not accept this position, as Keyt has pointed out, because Aristotle thought Plato's position was self-contradictory. Plato insisted that the Receptacle had no character of its own (Timaeus, 50B-D), but if Cornford is correct in calling Plato's space not "matter" as Aristotle does, but rather a "medium" (Cornford, Commentary, p. 177), then space does have the character of being a medium, as Keyt notes. The difficulty is that Plato not only speaks of the Receptacle as space, but he also speaks of spaces (\(\tau\rho\tau\tau\sigma\)), (Timaeus, 52B). Place or "spaces" is primarily a relation as opposed to an abstract "volumetric" concept. See David Keyt, "Aristotle on Plato's Receptacle," American Journal of Philology, Vol. 82, pp. 291-300.
to have volume.\(^1\)

It is in terms of volumetric rather than relational space that the question of the infinity of the universe is raised. Plato apparently believed that the universe was semi-spherical and thus limited;\(^2\) he considered it a unique phenomenon which is finite, and which does not have an unlimited void outside its shell. Thus Plato would neither say that the universe is infinite volumetrically, nor that there is an infinite volume or void beyond the universe.\(^3\)

Ontologically Plato\(^1\) insists that real being and volumetric space

\(^1\)Taylor develops the volumetric concept of space in discussing Plato, although he does not actually use the term "Volumetric Space." Taylor says that Timeus' conception of the Receptacle "involves forming a notion of volume in general." In this volumetric space "The life of nature is thought of as made of sensible events of specific types or patterns taking place in or over volumes. (It is understood, though not expressed, that these volumes 'overlap', so that they yield a whole volume-continuum which is filled by the whole 'passage of nature');" (Taylor, Commentary, p. 312). We must "say that what Timeus is expounding in 49-50 is not metaphysics, but the principia mathematicae philosophiae naturalis" (Ibid., p. 313). Taylor's attempt to distinguish the Receptacle as a mathematical rather than as a metaphysical concept may represent Plato's intention since space, like the forms, is not open to sense perception. It would seem, however, that the Receptacle has a greater metaphysical status than "becoming" for space is indestructible. Crombie agrees with Taylor that Plato was most at home with a concept of abstract volume [Ian M. Crombie, An Examination of Plato's Doctrines: Vol. II—Plato on Knowledge and Reality, (Vol. I-II, London: Routledge and Kegan Paul, 1965), p. 223].

\(^2\)Cornford, Commentary, p. 188.

\(^3\)The nature of the volume of the universe is perplexing even with the advance of relativity theory. Relativity, in fact, is more faithful in presenting the relational aspect of space than the volumetric aspect. In explaining the "expanding universe" theory Milne says, "The system may be said to create the space it needs as it expands," [E.A. Milne, Modern Cosmology and the Christian Idea Of God (Oxford: at the Clarendon Press, 1952), pp. 64-66]. What is not clear is how the universe "creates" volume.
can each never "come to be in the other."¹ Cornford comments that "The Form, we have been told, cannot receive anything into itself from elsewhere. This applies to Space, which can never enter into the existence of Forms."² Plato's "separation" applies not only to Being and Becoming,³ but also to Being and Space; because if they could enter each other "two should become at once one and the same thing and two."⁴ This logic reflects the influence of Parmenides on Plato, as exhibited in the dialogue on "The One."⁵ Unity is an inherent quality of the forms; but the "sphere" or volumetric space is not so much a unity as a "whole" since it contains indivisibles. Plato's cosmology in fact reflects the "old scheme borrowed in Republic V from Parmenides,"⁶ in which the trinity of being was

(1) the perfectly real and knowable, (2) the object of opinion (3) the absolutely unreal and unknowable. The third of these is not to be identified with Space, for Space is not unreal, and we can apprehend it. Plato's purpose is precisely to introduce Space, as an eternally real object, to fill the blank left by the totally non-existent in Parmenides' scheme, which consequently provided no support for any world of appearances.⁷

Cornford concludes that Plato's volumetric space was invisible as well as

¹ Timaeus, 52C.
² Cornford, Commentary, pp. 194-95; he continues, "But Forms are essentially bodiless. So the Form cannot enter Space, nor can Space enter the Form as extension" (Ibid.).
⁴ Timaeus, 52D.
⁶ Cornford, Commentary, p. 193.
⁷ Ibid.
spherical;¹ but the question raised by Aristotle still stands, "How can an image cast by an unchanging object on an unchanging mirror be itself inconsistent and fleeting?"²

Plato presented a view of volumetric space which is open to many objections, but nevertheless has been a live option of inquiry up to the present day. Plato in no way identifies this volumetric space with God, for it is essentially powerless. Neither does he identify the Forms with Deity. "God is a soul, not a form."³ It is God who establishes order in the Receptacle by imposing harmony on the sensible qualities in the universe. Understanding Plato's volumetric space is complex at the least; as Crombie commented,

It can only be grasped by bastard reasoning, though it plays some part in explanation; a compromise entity, the ghost of the Pythagorean 'unlimited', the germ of Aristotle's 'matter' and of Locke's 'something, I know not what'. But at the same time it is also just space.⁴

While not precisely summarizing Plato's view of volumetric space, Crombie's statement does point to the difficulties inherent within the Receptacle, that aspect of space which remains when all bodies are removed from it—volume.

b) Plato's Relational Space—the Triangles

We now turn to Plato's "Relational Space," his use of space in a dependent, limiting, relative sense. Plato did not see relational space as an aspect of what he called space (the Receptacle), but rather as an aspect

¹Ibid., p. 187.
²Ibid., p. 196.
³Taylor, Plato, p. 492.
⁴Crombie, Plato, p. 224.
of Becoming, of motion, of "elemental* existence. Relational space as we shall use the term may have volume as one aspect, but its main feature is that the spatial extensions will be related to tangibles as the context of "events," or "point-particles." Geometrically speaking, relational space may involve the relations of the points on a solid, a triangle, or on a line. It also involves relating moving bodies. In this sense relational space represents what relativity theory calls "coordinate systems,* and closely resembles what Newton called relative space.*

The concept of Relational Space is derivative of man's daily sensual experience. He notices some objects are spatially tangent, others are separate; bodies may be ordered according to a spatial sequence. Motion makes man aware that relational space is relative and changeable. Plato attempted to unite all relational space geometrically. Geometry was the common language of all space, the science by which the Demiurge endowed "the primary bodies with regular geometrical shapes.* And it is the shape of these bodies which contributes to our sensual experience of Becoming, while at the same time enabling us to speak of relationships intelligently.  

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2Newton speaks of both "absolute" and "relative" space in his Principia (p. 6), and Taylor uses the terms "relative" and "relational* interchangeably in his discussion of time and space (Taylor, Commentary, p. 681). With Einstein, however, the term "relative" space has taken on a more technical meaning.


4If we can grasp the Pythagorean understanding of the relation between geometry and Becoming, then we shall partially understand why mathematics and geometry held such a high place in Plato's Academy. Mathematics was a prerequisite for dialectic (Crombie, Plato, p. 81). And the purpose of an "Academic Education" was the "conversion (περιστοποιησις) of the soul from the contemplation of Becoming (γενεσθαι) to that of Being (ονομασια, (Burnet, Thales, p. 224). Mathematics and geometry were derived from the realm of Being, and it was the geometrical form imposed on sensible bodies which gave their underlying character the "image" of the permanent model, eternal being.
To speak of the relationships between sensible bodies is extremely difficult because of their impermanent character. But geometry is a science of spatial relationships which is not subject to time or Becoming, and is thus a suitable linguistic, symbolic expression of bodily relationships. Changing physical relationships are understood to be based on geometrical principles. The "movement" of water into air (or steam) is the transformation of certain geometrical patterns; it is this transformation which is the basis of motion, the basis of relational change. Of the four elements, earth is the most stable because its model is a cube or "a single equilateral quadrangle." Water is formed from an icosahedron, air from an octahedron and fire from a pyramid (because fire is the least stable element). These are the ideal figures of the elements since "every surface that is rectilinear is composed of triangles." There are in turn two basic triangles, the right-angled isosceles and the right-angled scalene. By properly adding these triangles together one can construct the five basic solids, the above mentioned four, plus the dodecahedron. Concerning the fifth solid,

1 In fact, it is only proper to speak about relationships expressed in an unchanging form, not about "things"; we cannot speak, argues Plato, about "this" fire because it is "becoming" (Timaeus, 49D-E). This problem led to Plato's epistemological conclusion that "for knowledge to be possible its objects must be other than sensibles" (Gulley, "Timaeus, 49 D-E," p. 54).

2 Timaeus, 55B; Cornford, Commentary, pp. 218, 222.

3 Timaeus, 55E-56B.

4 Cornford, Commentary, p. 212; Timaeus, 53C.

5 Ibid.; Ibid., 53D.
Plato concluded "God used it for the whole," that is, for the Receptacle, because the dodecahedron "approaches most nearly in volume" to the sphere. Thus geometry offers the common language of expression for both the volumetric and relational character of space.

Plato's geometric solids are different from the atoms of Democritus because they are limited in potential shape, whereas atoms were posited to have any shape. Geometrical triangles are the form on which all becoming is modeled. Furthermore, "If planes can be constructed of triangles, triangles themselves can be constructed of lines, and lines can be expressed as numbers." Timaeus as the fifth century Pythagorean believes numbers have geometric form, that, as Burnet points out, one can describe "the sum of the first four natural integers (1 - 2 - 3 - 4 = 10), thus—.....

Burnet has here illustrated how geometry and number were combined to give a rational, relational account of space. Numbers themselves are understood to have spatial relationships, as in the above sequence. One does not speak simply in terms of numerical relationships, but of numerical-spatial relationships, as with a rule of measure.

Timaeus discusses how the various elemental solid figures (cube, icosahedron, octahedron and pyramid) can interact and be transformed from one element to another. This development displays the interdependence

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1Timaeus, 550.
2Cornford, Commentary, p. 219.
3Ibid., p. 212.
4Burnet, Thales, p. 52.
5Timaeus, 56C-57D.
of number, geometry and sense-data within Plato's cosmological epistemological scheme. The multiplicity of geometrical shape among the elements is a cause of instability, which in turn is a cause of relational change in space, giving our physical existence the character of becoming. Geometry and mathematics provide a "timeless" science by which we can at any moment express the static relationship between two moving bodies, e.g. the moon and sun, or the change of water into air.

In this study other works of Plato such as the Phaedo, Republic and Parmenides could have been considered. The Parmenides hypothesis on "The One" is especially interesting; here the Greek philosophic mind grapples with the problem of unity. We read statements such as "If one is, it certainly will not be many;"1 "So neither can it have a part, nor can it be a whole."2 This approach to unity, based on Zeno’s axiom, demonstrated the fact that the mathematical idea of one does not satisfy the conditions of unity.3 In the second hypothesis Plato relates unity to existence and being.4 One of the controversies over this dialogue is whether or not one can substitute the concept of "God, Cosmic Mind, or World Soul" for the concept of "The One" in Plato's dialogue.5 Whether or not Plato intended any such substitution, such a substitution can be made without interrupting the logic of the arguments.6 Most important is the fact that unity was logically developed

1 Parmenides, 137d [Brumbaugh Trans.]. 2 Ibid., 137c5.
3 Brumbaugh, Parmenides, p. 86; cf. also Taylor, Plato, p. 200.
4 Parmenides, 142B4 ff. 5 Brumbaugh, Parmenides, p. 10.
6 Ibid., p. 11; we shall note later Newton's difficulty with the doctrine of the Trinity, and we will suggest that Plato's type of thinking about unity is a stumbling block for Newton. As Brumbaugh comments, "there are readers who find nothing absurd in equating the Trinity with the x, y and z" of an algebra text (Ibid.).
in a geometrical context, and thus unity was to quite an extent a spatial concept; unity and wholeness were not synonymous. Indivisibility rather than completeness was the test of unity.

In summary then, Plato's Relational Space, like his Volumetric Space, can be expressed in mathematical and geometric terms. Space is the situation in which "Becoming" takes place, in which the celestial objects move relatively to one another, and in which the four elements, constructed from triangles, are transformed relationally. Triangles can be constructed from "units," that is, numbers properly ordered; both a unit and a geometric point are indivisible. Plato's Receptacle, his Volumetric Space, was derived by abstracting the sensedata which constituted Relational Space, the world of changing triangles.

2) Plato's Time—Related to Eternity, Number, and the Universe

It may be legitimate to generalize that if Plato held something like a Newtonian concept of absolute space, he nevertheless supported a Newtonian relative or relational view of time.¹ Plato speaks of only one type of time.

¹Taylor would disagree with this contrast, who says, "By 'time' Timeus here means what is often called 'Newtonian' time, the 'absolute, true, or mathematical time', which, in the famous words of the Principia, 'flows equably'. It is thought of as measured, or rather numbered, by a succession of equal intervals, days or years or what not, just as in the Pythagorean arithmetic numbers were thought of as repetitions of an 'absolute' and indivisible 'unit'. The thing meant is . . . 'clock-time' (the clock being thought of as free from all defects of our actual time-pieces), "(Taylor, Commentary, p. 187). It seems peculiar that Taylor should call the time of Timeus Newton's absolute time, for Taylor, in another section of his Commentary, quotes Newton's definition of absolute as well as relative time (Taylor, op cit, p. 682). Newton speaks about "absolute . . . time" which "in itself, and of its own nature, apart from relation to anything else, flows equably and is also called duration;" but in contrast "relative . . . time is any sensible and external measure of duration by motion (whether exact or uneven). . . as an hour, a day, a month, a year," (Newton, Principia, p. 6). Although we agree with Taylor that Plato's time was "clock-time;" if we are to take Newton at his word, absolute time is duration which flows "apart from relation to anything else," not even, as one might expect, in relation to absolute space. This is not Newton's "clock-time;" his clock-time was his relative time, "whether exact or uneven," the "sensible and external measure of duration by motion" which is stating precisely the time of the Timeus, Newton's relative time. Apparently Newton's absolute time could not be measured or numbered, and it was separable from motion, none of which was true of Plato's time. Therefore, although we have called Plato's volumetric space analogous to Newton's absolute space, and Plato's relational space parallel to Newton's relative space, we nevertheless have found in Plato only one type of time, an apparently created time (which Newton's absolute time was not—it was constituted by God's duration). Plato's time corresponds to Newton's relative time, the time measured by motion, by the external movement of the heavens, or even by a man-made clock. Newton's absolute time, as independent "duration," seems closer, in fact, to Plato's idea of eternity than to his idea of time. We shall see that in fact there may be three types of time in Newton—relative, absolute, and infinite absolute.
whereas Newton spoke of absolute and relative time. There are the usual classes of time in science, and Tomb has suggested a third type, "metaphysical time, which is the duration of personality, is therefore an integration of consciousness, personality and memory." Tomb's definition of metaphysical time raises the problem of the relation of time as a category of knowledge to time as a psychological experience.

Plato said that God

took thought to make, as it were, a moving likeness of eternity; and at the same time that he ordered the Heaven, he made, of eternity that abides in unity, an everlasting likeness moving according to number—that to which we have given the name Time.  

Before "creation" there were no sensible measures of time in Newton's sense; there were no days and years before the ordering of the Heaven. One can speak of the three tenses of time, "but 'is' alone really belongs" to eternity, to the eternal form of which time is the likeness. And "'was' and 'shall be' are properly used of becoming which proceeds in time." Eternity does not change because it does not move, whereas time is unlike eternity in that it does move. For Plato the existence of time depends on the existence of the universe. "Time came into being together with the

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2 Timaeus, 37D; in this passage "likeness" could also be translated "image" from the word εἰκόνα.

3 Newton, Principia, p. 6.

4 Timaeus, 37E.

5 Ibid., 37E, 38; Taylor concludes, "It is not the 'is' which means 'is at this moment'; in fact it is a 'timeless present' as the 'gnomic aorist' in Greek is a 'timeless past'" (Taylor, Commentary, p. 188).

6 Timaeus, 38A.
the Heaven, in order that, as they were brought into being together, so they may be dissolved together, if ever their dissolution should come to pass. ¹

These statements do not exhaust Plato's comments in the *Timaeus* concerning time, but they are representative of his thought. The *Timaeus* treats the problem of Time (37C ff.) before dealing with the problem of the Receptacle or Volumetric Space (48E ff.). Our motive for dealing first with volumetric space is due to space's independent and permanent nature. As Cornford observes,

Plato's treatment of Time presents an important contrast to his treatment of Space. We are apt to speak of Becoming as going on 'in time and space', as if these two conditions were on the same footing. Plato does not so regard them. Time is here included among the creatures of the divine intelligence which orders the world. It is a feature of that order, not a pre-existing framework. Space, on the other hand, is introduced in the second part of the dialogue, under the heading of 'what happens of Necessity'. ²

Qualifying Cornford's statement, one could say that for Plato Becoming takes place in Newton's absolute space and Newton's relative time, and in this sense Becoming happens in space and time. Plato describes time as a "moving likeness of eternity" moving according to number. According to Callahan, "Far from stating that time is the measure of motion, Timaeus rather tends to say that motion . . . of the universe, is the measure of time, for the heavenly bodies provide the numbers of time." ³ Anything in

¹ *Ibid.*, 38B.

² Cornford, *Commentary*, p. 102.

motion does not have unity in Plato's system, but as a numerical series is "a kind of projection of unity," so time moving according to number suggests a multiplicity of times or "units" of eternity. The parallel difficulties here to the nature of unity raised in the Parmenides dialogue are clear.

Plato describes time (χρόνος) as the moving likeness (κινούμενον) of eternity (αἰών). In Presocratic philosophy, argues Von Leyden, signified "living force of human life" and that "Plato is to be credited with the introduction of this term in the sense of timeless eternity." Cornford discusses the various interpretations of "likeness;" but we conclude with Von Leyden that time is not so much in contrast with its model as intimately connected with it. Eternity belongs to Form or Being, Time participates in Becoming as well as in a sense belonging to it.

Plato's understanding of the relation between time and number is based on his view that time is a product of orderly astronomical process which is cyclical and measurable. Man's time is somewhat different from celestial time because the stars come "full circle, whereas the cycle of men's lives

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1 Ibid., p. 19.


3 Ibid.  


6 In relating number to celestial bodies Taylor says "They 'divide' or 'determine' the numbers, because we use their revolutions as unity for measuring time" (Taylor, Commentary, p. 192).
is limited, its beginning and end never combining.  

Von Leyden points to some of the difficulties involved with Plato's time, such as the fact that time seems to be infinite, in the sense that the cycles keep repeating indefinitely, making it more difficult to contrast time with eternity. In Plato's Timaeus "time for him is a likeness of eternity not only because, proceeding by number, it secures an ordered and regular world, but also because he thought that its nature is cyclical."

But Cornford insists that Plato's time stands in contrast with eternity, "the concept of duration without change, as the attribute of real being," which "was first formulated by Parmenides." This will raise the question, later, to what extent the circle is the proper model of the eternal. In any case, Plato's time is more worldly than transcendent.

There are several particular features included in Plato's concept of time. (1) It is dependent for its existence on two categories: (a) On Eternity from which its likeness is modeled; (b) On the orderly created universe from which it receives its progressive numerical character; (but it is equally true that time imposes a certain order on the universe). (2) Time is like eternity, but not synonymous with it. (3) Since time has been created it can be "dissolved," an open "eschatological" possibility, but not a necessity, perhaps not even a probability. (4) Apparently time

2 Ibid., pp. 42-44.
3 Ibid., p. 44; Cornford points out that this cyclical concept is rooted in the works of Empedocles (Cornford, Commentary, p. 104).
4 Cornford, Commentary, p. 102.
5 Timaeus, 36E suggests that the heavens have been launched for an everlasting time; cf. Taylor, Commentary, p. 190.
is good (not evil) in that it is a means by which the Demiurge sought teleologically to make the universe more like the pattern of the Living Being;¹ yet while time is good, it is not the perfection of eternity. (5) Geometry contributes to time's cyclical nature, and mathematics is part of the fabric of time's numerical, orderly character; through the medium of geometry and mathematics time derives its existence from the world of being.² (6) Since time belongs to the world of Becoming it can be connected with the idea of "process," in much the same sense as that idea was expounded by Whitehead.³ Cushman comments concerning Plato, "Customarily, he conceives change always in conjunction with time lapse."⁴ And herein lies the basic role of progressing time in the metaphysical concept of cause and effect.⁵ If these six features do not define Plato's time, they perhaps set forth some of its limits.

¹ Timaeus 37C-D: Callahan remarks, "Insofar as time has a moral significance for Plato, it is a good one, for we are able to lead a better life by observing these numbers and adjusting the motions within our soul to the perfect motions of the heavenly bodies" (Callahan, Four Views, p. 125).

² Von Leyden maintains that "mathematics, i.e. both numeration and measurement, is a means of establishing a state of being in the midst of the world of becoming" (Von Leyden, "Time," p. 41).

³ William D. Geoghegan, Platonism in Recent Religious Thought (New York: Columbia University Press, 1958), p. 62; cf. also pp. 110 ff. Also Whitehead, Nature, pp. 53-54. "Nature is process" (Ibid., p. 53). "The process of nature can also be termed the passage of nature." "Also the passage of nature is exhibited equally in spatial transition as well as in temporal" (Ibid., p. 54).


3) Plato's Space, Time and Experience—the Circular Fluxion of a Point-Soul

We have presented a somewhat "mechanical" analysis of Plato's concept of Volumetric Space (the Receptacle), Relational Space (the motion of the heavens and the elements interpreted geometrically), and Plato's understanding of Time. This mechanical account perhaps would satisfy a physicist, but Plato's *Timaeus* actually relates this external world of space and time to man, specifically to what the Greeks called man's soul or mind. To be sure, the relation of the soul and time in the *Timaeus* is highly illusive, and highly allegorical. Plato left the interpretation of *Timaeus'* symbolism open to the reader's imagination, as a work of art should. Any attempt to explain the relation of the *Timaeus'* concept of the soul to space and time, however, should undoubtedly be formulated in terms of a geometrical and mathematical model. Plato's analysis of the world-soul follows a geometrical pattern. And although Plato does not actually use the expression we have chosen, apparently it is his intention to portray the human soul and its activity as analogous to the circular fluxion of a geometric point, the basic image of the soul's activity in space and time.

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1 *Timaeus*, 34A-37C.

2 The Greek word for "fluxion" is κίνησις (related to locomotion). The concept of motion and action in Greek thought is complex not only in terms of ideas, but also linguistically. Stenzel says the role of the verb in Greek thought, and in Plato in particular, is not clear. "Not only is this want of clearness a feature of ancient thought, but it is also deeply rooted in the problems with which it was concerned. Is existence a substantive or a verb?" [Julius Stenzel, *Plato's Method of Dialectic*, Trans. and ed. D.J. Allen (Oxford: At the Clarendon Press, 1940), p. 126]. This question undoubtedly points to the attempt to express "Becoming" in terms of geometry.
Our conclusion is based on a synthesis of several passages in the *Timaeus* as well as suggested interpretations of various scholars. In order properly to understand the relation of the soul to space, time, and eternity, and thus ultimately to eternal life or immortality, we must have a clear understanding of what Plato intended by the statement we cited earlier that the father made "of eternity that abides in unity, an everlasting likeness moving according to number--that to which we have given the name Time."\(^1\)

Plato derives time from eternity in an ontological sense. Time is dependent on its eternal image as its source. Eternity is the father of time. But epistemologically Plato seems to begin with the phenomenal (time) and concludes with the noumenal (eternity). Eternity and time have mathematics in common; eternity abides "in unity," and time moves according to number. The ontological relation between eternity and time seems to depend on the definition of a "Unit."\(^2\)

The Pythagoreans held two ways of conceiving extension, as Limit and as the Unlimited.\(^2\) The primary numerical limit was the Unit, the number one, from which all succeeding numbers are derived. The primary geometrical

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1 *Timaeus*, 37D.

limit was the point, which corresponds to the unit or number one. The point was conceived either as having no linear magnitude or as having an infinitesimal linear magnitude. In any case, the point was conceived as indivisible, as the "Unit" was by definition indivisible. It is generally agreed that eternity as used by Plato means "a timeless present," the concept of duration without change first formulated by Parmenides. "The 'indivisible' being of Plato's intelligible world demands duration that 'abides (rests) in unity'." 2 "Is" alon is the proper description of eternal being. We are led to conclude that eternity, because it abides

1 Relating the number one to the geometric point is the beginning of the problem of "incommensurable magnitudes." (Cf. M.C. Evans, "Aristotle, Newton, and the Theory of Continuous Magnitude," Journal of the History of Ideas, Vol. 16, pp. 548-57.) The geometric point can be conceived in two ways: (1) The point can be defined as having no linear dimension. (2) The point can be defined as having an infinitely diminished linear dimension, infinitesimal extension. While its extension is too minimal to be subdivided, nevertheless, when two such points are placed adjacent to each other they form a straight line. (A third definition of a point may be possible, although it has not been considered in any of the material we have encountered relevant to the subject. A point may be defined as the exact geometric centre of a circle or sphere.) Although Plato considers the triangles as the basis of the visible world in the Timaeus, Miss A.T. Nicoll in an article "Indivisible Lines," Classical Quarterly, Vol. 30, p. 125, demonstrates that Plato understood the number, point, line, plane, solid series on the basis of Laws 894A. The problem is how to derive a line, plane and solid from each definition of a point. In the first case the point can form a line only by motion, by the fluxion of a point; by the fluxion of a line a plane is formed, by the fluxion of a plane a solid; such a notion would result in a "4 cornered plane" and an "8 cornered solid." The number series relating point, line, plane and solid would be (1, 2, 4, 8). But according to the second definition of a point, a line can be formed by the addition of points, a plane by the addition of lines, solids by the addition of planes. In this case the addition could be of points obliquely from one end of a line, forming a triangle, and further addition could form a "4 cornered solid." Then the numerical series would run (1, 2, 3, 4). The fluxion as opposed to the addition theory is probably later in date, and may have represented an attempt to cope with the difficulty posed by Thales's arrow (cf. Guthrie, PreSocratics, p. 264); at any rate, Plato seems familiar with both theories.

2 Cornford, Commentary, p. 102.
in unity, is an indivisible, immovable, timeless present. The question is, what is the proper model by which this concept may be expressed?

The traditional image of eternity is the circle because it represents perfection and completion, and this symbol of eternity is undoubtedly a persistent one in Greek thought, replaced in later cosmology by the "eternal spheres." Plato calls time the moving image of eternity, and as we saw earlier time moves in a circle. Consequently one may conclude that eternity is represented geometrically by a circle, perhaps one which does not move, for the main contrast between time and eternity seems to rest on the fact that time moves (according to number), while eternity is immovable (abiding in unity). If eternity is represented by a circle, time is best imagined as a moving circle or wheel. And an analogy may be drawn between the movement of the heavens, the instruments of time (ὁσιάριον ἄθροισ), and the movement of a wheel or sphere. If eternity is like a circle, then the best graphic image of time would be a clock with a face that rotates while a stationary "hand" or pointer numbers the changing position of the face.

Although the circle is undoubtedly a valid representation of eternity, difficulties follow. (1) A circle is divisible; time proceeds by numbering 360 divisions in one circle (year); but eternity abides in unity, as Parmenides as well as Timaeus insisted, and the geometric point, not the

---37---

1 Cf. above pp. 28-33.

2 Von Leyden, "Time," p. 40; cf. also Timaeus, 41E.

3 There is a sense in which a circle is indivisible; if a circle is bisected, two semi-circles result, whereas if a line is bisected, two lines result. Division of a circle destroys its "cirleness."
circle, was the basic geometric unit because it was indivisible. (2)

The question must be raised, why is not the circle of eternity as well as of time movable? Stated in another way, if the heavens, which be revolving constitute time, were to stop revolving, would they then represent eternity? It seems unlikely. (3) If one point on the circle of time can be called "now" or "is," with a "before" and "after," why cannot there be a "now," "before" and "after" on the eternal circle? (4) Our fourth difficulty is that the eternal forms such as beauty and goodness seem to be non-spatial in character, and in this sense a circle as a spatial representation of eternity seems inappropriate. As Cornford comments, space "is not a genuine intelligible object, because it has not status in the world of Forms; these, as Plato goes on to say, are not in space, nor are they extended."¹

We are going to suggest that the best "image of eternity" is not the circle, but the geometric centre-point of a circle. This interpretation seems to be in line with the direction taken by Plotinus, who followed Plato in describing time as the moving image of eternity, and formed a definition of eternity as unity upon which to base a definition of time. Apparently Plotinus concluded that eternity or unity is like the centre of a circle.²

¹Cornford, Commentary, p. 193.

²Callahan summarizes Plotinus' position saying "eternity must not only be at rest, but possess unity and be without extension" (Callahan, Four Views, p. 90). "Then we see eternity as the life that is forever unchanging and possesses all its reality in the present. There is no succession involved in this life since nothing has passed and nothing is to come, but whatever it is it is always" (Ibid., pp. 90-1). "Thus we find that eternity is the life of being in its very being, at once whole, complete, and entirely without extension" (Ibid., p. 91). "Thus we are led once again to eternity. It is that which is, and this uniform self-identity Plotinus has demonstrated by taking the Platonic concept of unity in the Timaeus and transferring it to his first hypothesis, the One, which is the source of all being as the source of all unity and goodness, but is itself beyond all being and, as Plotinus often insists, beyond all real knowledge. So the intelligible essence (the second hypothesis, intermediate between the One and soul), may be thought of as an unmoving circle which has the One or the Good as its center, and it is this proximity to the very source of all unity that gives to the intelligible essence the kind of life that we call eternity" (Ibid., p. 92). Except for the fact that Plato moves directly from eternity to time, or from the centre of the circle to the moving point on the circle, Plotinus seems to have found essentially Plato's intended meaning. Callahan suggests that the concept of Unity and Ideal Numbers in Plotinus prevents him from speaking of Plato's time as moving according to number (Ibid., pp. 121-22). Actually, Plotinus' difficulty in expressing time as moving number is also due to the fact that he has developed a basically geometric as opposed to numerical concept of time.
To avoid the divisive, mobile, spatial character of a circle, one can imagine that eternity which abides in unity is a geometric unit, a geometric point.  

(Eternity as "life" in this sense is analogous to the concept of the "seed," which, like the soul, is the source of life).  

In fact we suggest with Plotinus that eternity is like the centre of the circle or sphere of time, a centre which, like eternity, "is forever in the same state immovably" and "cannot be becoming older or younger by lapse of time."  

Remembering that the character of the eternal is expressed as a timeless present, then the model of time is the unity of a moving "timeless present," a moving geometric point. In this analogy rather than concentrate on the "rim" we focus on the "spokes" of the wheel, or on the celestial bodies as the instruments of time. Taylor says that "the language of Timaeus plainly identifies time with the uniform movement of a planet."  

In the geometry of astronomy the planet is represented by a "point," and a moving planet is thus a moving point, a "moving image of eternity." The celestial bodies each represent a kind of moving "now-point," the constant "is" which is common to both eternity and time. The difficulty arises when all the heavenly bodies are taken collectively, and the concept of the sphere is developed. It is possible to see both a moving star or planet and the moving "sphere" as the instruments of times (Ὄρυμα Χρόνυς) or as the instruments of time (Ὄρυμα Χρόνου). Callahan vacillates; the heavenly bodies "are the instruments by which the maker fashions the moving

---39---

1 Taylor, Commentary, p. 187.  
2 Callahan, Four Views, pp. 119 ff.  
3 Timaeus, 38A.  
4 Taylor, Commentary, p. 191.
image of eternity, though it is still true that the wanderings of these bodies are, in their totality, the moving image itself, ¹ and that each body "is in a limited way an image proceeding according to number, though the numbers in any individual case are less complex than those of time as a whole."² By projecting the eternal-centre-point of a circle onto its circumference and moving that point (as a planet moves) we have the moving geometric image of eternity which abides in unity. Time as a moving now-point is represented graphically by a clock whose face is stationary, but which has a pointer projected from the centre moving around the face according to number. The moving spokes of the wheel make us aware of the moving now-point which is the projection of the immovable "hub" or centre point of the wheel, the centre which always is. According to this definition, circular motion rather than linear motion is the best motion for time because it moves around its eternal centre source; time is the image of eternity (which abides in unity) projected onto a circle proceeding (moving) by number (one unit after another; 1, 2, 3...360).

The main difficulty with this definition is that the centre now-point of eternity appears to be contained within and to depend upon the circle of time, and the eternal forms are not contained by anything according to Plato.³ The image of a moving now-point, however, seems to represent more closely the way in which the concept of time is empirically measured by astronomy through the aid of geometry, and it also seems to correspond more appropriately to Plato's idea of becoming. For these reasons we prefer the circle-

---40---

¹ Callahan, Four Views, p. 21. ² Ibid. ³ Timeus, 52C.
centre-point rather than the circle as the most likely intended geometric model of eternity of which time is the moving image.

It is on the basis of time as the now-point moving in a circle that we shall raise the question, What is the relation between man's soul and time and space? But first we must ask, what was the Platonic and Presocratic conception of the soul? The human soul was born of the Universal Soul; one theory of the soul held that it was "self-moving numbers." Aristotle was critical of the self-moving concept because if "a moving point (generates) a line, the movements of units will also be lines, for the point is a unit having position." Heraclitus identified the substance of the soul and the stars.

Aristotle, undoubtedly in reference to Plato, spoke critically of "those who define the soul as that which moves itself;" the stars which served as geometric points in astronomy were also understood to be self-moving. Man had several different types of soul, but intelligent soul was motion within the head which is spherical in shape to accommodate the circular motion of the indivisible soul, which as self-moving number is a unit-point. Eyesight is the sense which most purifies the rational soul because it enables

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1 Guthrie, Presocratics, p. 263.
2 Metaphysics, 103b12 [cited by Guthrie, Presocratics, p. 262].
3 Guthrie, Presocratics, p. 481; Timaeus, 41D-E.
4 De Anima, 404a20, Guthrie, Presocratics, p. 350.
5 Timaeus, 44D; Guthrie, Presocratics, p. 350.
us to "observe the circuits of intelligence in the heaven and profit by them for the revolutions of our own thought, which are akin to them." 1 By comprehending the celestial motions our inward "wandering motions" are set on course. 2 There are seven directions in which a geometric point (and perhaps a body) may move: up, down, left, right, forward, backward, or in a circle or arc. The celestial sphere has the motion proper to its bodily form, namely that one of the seven which above all belongs to reason and intelligence; accordingly he caused it to turn about uniformly in the same place and within its own limits and make it revolve round and round; he took from it all the other six motions and gave it no part in their wanderings. 3

Plato is of course synthesizing a highly mythical Presocratic world view which may have begun with Heraclitus, Empedocles, the Orphic cult, the secretive Pythagorean school, and perhaps was adopted by Plato's pupil Xenocrates, a view Aristotle criticized in De Anima. 4

We are now prepared to ask, what is the relation between soul, time and space in Greek philosophy? Scholars such as Cushman and Guthrie have emphasized the external spatial measure of time as the major Greek concern, 5

1 Timaeus, 47B. 2 Ibid., 47C.
3 Ibid., 34A.
4 Guthrie, Presocratics, pp. 207, 262-63, 318, 450, 480-81.
5 Cushman says, "Time and Becoming are cyclical. Plato therefore leaves us with the melancholy result that we can only have processes, in contrast with Being, by having it in the form of everlasting recurrence." "Plato's time is either physical or organic; and primarily it is physical rather than organic." "Plato's time was physical time or 'clock time'. This is the measurable movement of any body in uniform motion in space" (Cushman, "Greek," p. 257). This "physical" or "mechanical geometric" time will come to dominate the seventeenth century.
but few have shown that this external physical analysis has experiential internal application which satisfies the soul (or psyche). Time is measured by the motion of celestial bodies, the recurrent seasons, the birth and death cycle; but such an account according to Guthrie suggests that "If time is circular and recurrent, we may just as well be described as living before the Trojan war as after it."1 While men such as Cullmann insist that Christian time is really like a straight line, not a circle,2 Taylor concludes that time is "not really a straight line."3 No geometric model properly represents time, or our experience of time. Nevertheless, the circular model satisfied the Greeks, and the straight line model satisfies many moderns.

Lack of sympathy on the part of modern scholars with the circular concept of time, however, has clouded the fact that the Greek external measure of time had important personal consequences. Time was important because it introduced order in the midst of chaos; the circular motion of the heavenly bodies was orderly, intelligent motion. According to Plato straight or linear motion (the first six directions), if not evil, at least belonged to the lower order of motion, and the suggestion that our soul experienced time as linear rather than circular would be most irrational. The fact that a parallel was expressed between the substance as well as the motion of stars and souls gives us our clearest expression of

1 Guthrie, Presocratics, p. 352.


3 Taylor, Commentary, p. 690.
the relation between the external and internal experience of "time." We experience time as something like motion; yet there is something in us which seems to be constant in the passage of time, that which we call the "present." And the Greek mythology expressed the dual nature of this experience quite well. The movement or fluxion of a celestial "now-point" is parallel to what we call our personal experience of time as process, that which Plato labeled "Becoming." The Greeks concluded that since the circular movement of a star is like the circular movement of the soul in the head, that the soul must experience time as circular; "was" and "shall be" can be numbered on the circle in reference to that moving now-point. Thus there does not seem to be, for the Greek, any difference between the external measure of time and the internal experience of it. The experience of time was like the experience of "seeing" celestial motion through space. Of course, unlike the stars, men die because, as Aristotle quotes Alcmeon as saying, "they cannot join the beginning to the end." The soul does not

---44---

1 For Plotinus "Time, which was previously implicit in the power of soul before that power became actually engaged in production, now moves along with this new, extended life of soul as a line is generated from a point, and thus time exists in imitation of eternity" (Callahan, Four Views, p. 131).

2 Taylor concludes that the whole connexion between soul and star "is simply to place every soul in a position from which it can get a 'bird's-eye view' of the order and law which reigns in" the universe (Taylor, Commentary, p. 257). But time is an aspect of order not only viewed by the soul, but also experienced by it.

3 Guthrie, Presocratics, p. 351, quotes Aristotle's Problematika; he also notes that "the individual human soul, is trying to reproduce in its own way the eternal circular motions of the divine stars" (Ibid., p. 353).
seem able to complete its orbit within the body.

If the soul is so intimately related to time, space and motion, how can it be related to eternity? Taylor is correct in saying that the soul is the meeting point of time and eternity, because while Plato’s time is related to process, what the mind knows is "timeless."³ Pythagorean geometry is important as an epistemological tool, as a timeless expression of becoming, even as a timeless expression of time. If the soul is a dimensionless "point" which is aware of a timeless present, then in this sense the soul is like the eternal.

The soul is immortal. The stars are also immortal, everlasting throughout all time.² Immortality is not something the soul gains when the body dies, but is rather part of the soul’s created nature. The soul is immortal for two reasons. (1) Like the stars, the human soul was an entity of the divine, and "Divinity to a Greek mind was synonymous with everlasting life."³ (2) There is also the argument, valid for stars as well as souls, from the circular-self-motion which Plato developed in the Phaedrus, and may be

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¹Taylor says, "This is why an intelligent mind (a ψυχή in which, as Plato puts it, there is ράμακτος), is, so to say, a mediator between time and eternity. It is on the confines of both and has a foot in each. The Neo-Platonists formally expressed this by saying that the being (οὐράκτης) of the ψυχή is eternal, but all its activities temporal, whereas both the being and activities of ράμακτος are eternal, those of the physical nature both temporal" (Taylor, Commentaries, p. 678). The same relation should be true of God, but is not because "in the Timaeus the Demiurge (i.e. God) actually makes both ψυχή and time" (Ibid.). Plato does not solve the problem of how to relate God to ράμακτος and ψυχή. The Neo-Platonists identified God with a 'pre-eternal' One which they identified with the "Good" in the Republic which stands above ράμακτος and ψυχή (Ibid.).

²Timaeus, 38C.

³Guthrie, Presocratics, p. 480.
summarized as follows, "The ever-moving is immortal, the self-moving is the ever-moving, therefore the self-moving is immortal. Soul is the self-moving, therefore soul is immortal." But only one motion is proper for the soul, that is orderly, circular motion, the motion (in space) of the stars and of time. Space gives man's soul the freedom to move in seven directions, the first six the directions suitable to "bodies;" the seventh the circle. The study of geometry is thus the key which unlocks the knowledge leading man to happiness in this world of time and space; geometry is the transcendent science which purifies man's soul, or in Plato's own words:

Now there is but one way of caring for anything, namely to give it the nourishment and motions proper to it. The motions akin to the divine part in us are the thoughts and revolutions of the universe; these, therefore, every man should follow, and correcting those circuits in the head that were deranged at birth, by learning to know the harmonies and revolutions of the world, he should bring the intelligent part, according to its pristine nature, into the likeness of that which intelligence discerns, and thereby win the fulfilment of the best life set by the gods before mankind both for this present time and for the time to come.

This summary statement of Plato expresses the teleological goal of man, or man's immortal soul, which makes its proper way in a world of time and space (becoming) by laying hold of the eternal, rational, intelligible through the sciences of number, geometry and astronomy. It may be said generally that the world view of the Timaeus involved a pseudo-scientific


2Timaeus, 90C-D; Stenzel points to the intimate relation between the mind and the sphere of the cosmos (Stenzel, Dialectic, pp. 165-66).
geometric mysticism by which the world of time, space, and soul was synthesized. Space is Volumetric and independent in the sense of the Receptacle, that which receives becoming into itself; space is also Relational, offering the contextual experience of motion and change, change which can be expressed in terms of triangles. Time is the ordering element in the universe of spatial change; it is the moving image of eternity, the basis of the link or bridge between eternity and becoming. Time is the projected image of eternity which abides, like the centre of a circle, in unity. This centre is projected onto the circumference of its circle and as a moving "now-point" time proceeds to form a circle according to number. As stars and time proceed in the Receptacle, so the soul and time proceed in man's head. The motion of stars, souls, and times is Relational; but the whole Relational experience is Volumetric.

C) Aristotle's Space and Time in the Physica

If the Timaeus was one for the most influential works of Plato on Christian thought during the Middle Ages,¹ the same may be said of Aristotle's Physica which contains his most concise statement of the nature of space and time.² Callahan has been criticized for relying on Aristotle's views of motion and time in the Physica as his normative view,³ and we are


probably open to the same criticism. Although several of his works, such as his *Metaphysics*, *De Caelo*, and *De Generatione et Corruptione*, show some concern for the nature of space and time, Aristotle's most systematic treatment is found in Book IV of the *Physics*. It is valid to use the word "systematic" in referring to Aristotle's analytical and logical method in the *Physics*, which sets it in sharp contrast to the synthetic, mythical, poetic character which Plato adopted to represent the unified world view of the Pythagorean *Timaeus* who joined physical science, mathematics, geometry, and ultimate existence.

1) Preliminary Concepts Necessary to an Understanding of Aristotle's Space and Time

The science of physics, according to Aristotle, ranks third in the order of knowledge following metaphysics (the study of first principles) and mathematics (the study of numbers and spatial figures having only "adjectival existence").¹ In Books i and ii of the *Physics* Aristotle sets forth the problem of first principles, conditions and elements,² as well as his four types of causes,³ the agents of change. He concludes with a discussion of the teleological concept and its relation to necessity.⁴ Nature is a synthesis of matter and form, and it is from the form that necessity receives its teleological character.⁵ Thus nature's dualistic character results in motion and change as matter seeks to conform, and it is within the "principle of motion and change"⁶ that we discover the "necessary conditions of motion."

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²*Physics*, 184a ff.
³Ibid., 194b16 ff.
⁴Ibid., 198b10 ff.
⁵Ibid., 199a30-33.
⁶Ibid., 200b10 ff.
i.e. place, void and time.¹ (That place and void (space) and time are related to motion suggests immediately that Aristotle holds a somewhat Relational view of space and time). These concepts are in turn analysed in terms of contraries such as solid and void, hot and cold, up and down, before and after.² Equally important in physical analysis are the categories, most of which are either spatial or temporal in character: substance, quantity, quality, relation, place, date, position, state, action, passivity.³

Aristotle's general epistemological and scientific method is one of division, from genus to species (the method taught by Socrates); the whole may be known by summing its parts, by investigating principles, conditions, or elements related to causes and categories. Consequently Aristotle's physics has the character of analytical and constructive logic which sees mathematics and geometry more as a tool of physics and logical analysis than as the Pythagorean mythical principle of the universe.

Aristotle is very concerned with the concepts of potential and fulfillment in relation to change and motion (the embryonic form of the concept of potential energy and kinetic energy respectively in classical physics); these concepts are part of Aristotle's teleology. Aristotle defines motion as the "fulfilment of what exists potentially."⁴ Change and motion are similar, but change might involve quality and not motion in the sense of locomotion (κίνησις).⁵ Motion and change involve coming to be and

¹Ibid., 200b10 ff. ²Ross, Aristotle, p. 64. ³Ibid., p. 21. ⁴Physica, 201a10. ⁵Ibid., 201a12-14; P. D. Ross in the Preface to the Hardie and Gaye translation of the Physica says that of all the technical terms in the work "The most difficult, perhaps, is κίνησις."
passing away; motion, which is a form of change, can be numerically expressed. "The science of nature" says Aristotle "is concerned with spatial magnitudes and motion and time, and each of these is necessarily infinite or finite, even if some things dealt with by the science are not, e.g. a quality or a point."\(^1\)

Although Aristotle begins to discuss motion at the outset of Book III, the last two-thirds of the book involves a discussion of the infinite.\(^2\) A clear account of Aristotle's basic understanding of the infinite is pre-requisite to the proper interpretation of his ideas of time, place, void and space. Ross summarizes Aristotle's view of the infinite by naming two infinities, (1) that of addition, and (2) that of division. And "number is infinite in the first sense, space in the second, and time in both."\(^3\) There is no infinite body. Logically the infinite is either a substance or an attribute; therefore "the Pythagoreans are in error when they make the infinite both a substance and divisible."\(^4\) Belief in infinity is the result of an analysis of five basic considerations: (1) the infinite nature of time; (2) the division of magnitudes; (3) the infinite source of becoming; (4) the apparently infinite series of every contained thing having a container or limit; (5) the rational experience of mathematical infinity.\(^5\)

\(^1\)Ibid., 202b30-33; Aristotle here places a geometric "point" in the class of the non-spatial, non-material, with "quality;" this is extremely significant, for in dealing with Plato's concept of "Eternal Being" we suggested that it had the character of a geometric point. In discussing Anaxagoras' theory of the origin of "coming to be" Aristotle says, "One such source there is which he calls Mind, and Mind begins its work of thinking from some starting point. So necessarily all things must have been together at a certain time, and must have begun to be moved at a certain time" (Ibid., 202b30-33). Perhaps the analogy between Mind (Eternal Being) and "starting point" should not be taken literally, but it is a suggestive image of eternity, not contrary to Plato's image.

\(^2\)Ibid., 202b30-208a28.

\(^3\)Ross, Aristotle, p. 83.


\(^5\)Physics, 207b15-24.
Aristotle admits that "the problem of the infinite is difficult; many contradictions result whether we suppose it to exist or not to exist." He agrees with Plato that there are two infinities, "the Great and the Small," the infinite "in respect of addition or division or both." But these infinities are only potential and mathematical in character, not actual or physical. In an arithmetic progression by addition one can potentially move toward infinity, but one never reaches infinity in experience, and consequently infinity does not have an actual existence.

Time and movement have the character of the infinite "in the sense that each part that is taken passes in succession out of existence." But "Magnitude is not infinite." Time and motion have an infinite character because they "belong to the class of things which are continuous." This points again to the problem which Evans labels "continuous magnitude," the relation between points in lines, or moments in time. "Aristotle was clear that time was not composed of instants, nor a line of points."  

2) Aristotle's Concept of Space as Place—At once Volumetric and Relational  

since Aristotle begins with the concept of matter and its relation to

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1. Ibid., 203b30.  
2. Ibid., 203a15.  
3. Ibid., 204a8, 206a15.  
4. Physica, 204a34-35; cf. also Metaphysics, 1066b21-26.  
5. Physica, 204b4 ff.  
7. Ibid., 200b16-17.  
infinity, then matter as that which occupies space suggests that the place of matter is the most basic spatial concept. Space or place does not have the character of infinity by addition because of its dependence on body. Claghorn suggests that the reason Aristotle does not believe in a vacuum or void,\(^1\) is because of his conception of a substratum of matter underlying the universe.\(^2\) Matter can be identified with body and body with space.\(^3\)

"'Body' is what has extension in all directions and the infinite is what is boundlessly extended, so that the body would be extended in all directions ad infinitum."\(^4\) But then the six basic directions would lose their individuality, and one could no longer distinguish one body from another; and besides, we know of "no such sensible body."\(^5\) Claghorn contends that Aristotle and Plato share almost identical positions about time and space. Yet such a conclusion seems somewhat oversimplified in the case of space. For instance, Claghorn concludes that "the Receptacle in many ways seems to correspond with Aristotle's prime matter."\(^6\) Since Aristotle had thoroughly studied the *Timaeus*, however, he had the opportunity to adopt the idea of the Receptacle, and he obviously chose not to do so. Claghorn's basis for relating Plato's Receptacle to matter as the mother of Becoming is that Plato seems to speak of things made in it (the Receptacle).\(^7\)

\(^{1}\) *Physica*, 214b11-216b20.


\(^{3}\) *Physica*, 209b5-17.

\(^{4}\) Ibid., 204b20.

\(^{5}\) Ibid., 204b20.

\(^{6}\) Claghorn, *Aristotle's Criticism*, p. 18.

\(^{7}\) Ibid., p. 7; cf. *Timaeus*, 49E, 50E-5, 52A-B.
Aristotle thought that Plato identified space and matter. According to Claghorn this interpretation by Aristotle is in reference to Plato's gold analogy, and that it reflects the fact that Aristotle is a reliable interpreter of his teacher. But we agree with Cornford who says that the gold analogy is weak in portraying Plato's intention, because "the figures are made out of gold and consist of gold; but the contents of the Receptacle are not made out of it." Rather the relation of the Receptacle or Space to its contents is that the contents can take many shapes or spatial forms in the Receptacle, as the same gold can be remodelled infinitely. But Plato is not trying to say that space is material in the sense that gold is material. He is saying that the basic nature of space permits an infinite number of shapes. But Plato never says how matter "becomes" in space, a shortcoming of his work. The Receptacle is independent of matter, as the Nurse of the child, whereas with Aristotle's conception the mother and child are interdependent, (although he does not employ the mother-child analogy). It might be truer to say that for Aristotle the analogy should

1 Physica, 209b11; cf. Timaeus 52.
2 Timaeus, 50A-C. 3 Claghorn, Aristotle's Criticism, p. 8.
4 Cornford, Commentary, p. 182, n.1.
5 Timaeus, 49A-50D; cf. Cornford, Commentary, p. 185.
6 Keyt suggests that Aristotle held four conceptions of "place," his basic spatial concept. Place may be matter, form, the boundary of the containing vessel, or extension. [Extension is the definition adopted by Descartes.] Aristotle's conclusion that extension is Plato's basic concept of space is correct, says Keyt. "However, since the third factor functions as a medium, it must be more than extension alone" (David Keyt, "Aristotle on Plato's Receptacle," American Journal of Philology, Vol. 82, p. 300).
be reversed; matter is the mother of space, the child. By beginning with the already existent child Becoming, Aristotle sees no need for a Receptacle, for a pre-existent Volumetric Space. Aristotle's position is clarified in his discussion of the void and volume.¹ He says the magnitude of a cube is "different in essence from all its attributes, even if it is not separable from them; I mean the volume of the wooden cube."² Although the volume of a cube is "different" from the cube, it is not separable from the cube (or matter). And since a wooden cube can be displaced without changing volume, "why need we assume a place for bodies over and above the volume of each?"³ Aristotle sees the need for only enough volume in the universe to accommodate all the existent cubes or bodies; he is very "economic" in his scientific explanations.⁴ The topic of "place" is treated in the beginning of Book iv;⁵ then, having shown place and matter to be interdependent, Aristotle deduces the impossibility of the "void."⁶ Nevertheless there is a sense in which "Place is no part of the thing," and "Place can be left behind by the thing and is separable."⁷ This is a "container" space of a type for Aristotle, an absolute space, in that each individual "place" is absolute. But space

¹ Physics, 214b12-216a26; for Aristotle there is no void "separate from bodies" (Ross, Aristotle, p. 87).
² Physics, 216b4-6. ³ Ibid., 216b12-14.
⁴ Newton's first "Rule of Reasoning in Philosophy" was, "We are to admit no more causes of natural things than such as are both true and sufficient to explain their appearances" (Newton, Principia, p. 398).
⁵ Physics, 209a27-213a11. ⁶ Ibid., 213a12-217b28.
⁷ Ibid., 211a1-3.
is not the necessary pre-existent "something" in which matter or Becoming can enter and be born. ¹ Thus while Aristotle's "place" is Relational in character, it is at the same time absolute and Volumetric.

The starting points of Aristotle and Plato in surveying the universe seem to be different. Plato surveyed the universe and found that its volumetric character is apparently permanent although it contains Becoming,² the phenomenon of change. Before Becoming could become, a container for it was necessary. Aristotle began with matter, or body, that which "has extension in all directions,"³ and concluded that space, place, or a volume, which were nearly identical for him, were an accident or attribute of changing matter.⁴ This is indeed a relational space. Claghorn is correct in saying that Plato's Receptacle and Aristotle's Prime Matter have much in common. The different starting points, however, cause Plato to conclude that space is the unchangeable basic feature in which "becoming" takes place, while Aristotle, beginning with sensible matter, which necessarily is extended, concluded that space is in a sense an illusion; it is not necessary to establish a pre-existent Receptacle in order to develop

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¹ Place constitutes Aristotle's Volumetric Space as well as his Relational Space; one puzzle for Aristotle is the exact sense in which we say a body is "in" (ἐν) place (τόπος); i.e., as wine is in the bottle (Physica, 210b17-22), or as "hot" is the affection "in" a body (Ibid., 210b24-26); cf. Taylor, Commentary, p. 670-71, for a discussion of seven uses of "in" in Aristotle.

² Taylor, Commentary, p. 312, 320.

³ Physica, 204b20; we shall see that this definition of body as "extension" was the basis of Descartes' physics.

a working interpretation of nature.¹

Because he concentrated on the concept of place (of a body) when analysing space,² Aristotle's concept of place involved both Volumetric and Relational aspects. Plato developed a separate treatment of Relational Space in terms of motion and the triangular interactions of bodies; Aristotle has no need for such a treatment, because for him the Volumetric and Relational aspects of space are both derivative of pre-existent matter. Aristotle spoke of the volumetric character of space when he wrote of "the volume of the wooden cube."³ But the volumetric limit of the universe is the total volume of all bodies.⁴

Place was teleologically significant for Aristotle because the elements tend to be drawn towards their natural place; fire up, earth down.⁵

¹Because matter in motion and change is Aristotle's basic concept of nature he is forced to postulate the Unmoved Mover. He says, "it is clear that the first unmoved mover cannot have any magnitude. Now we have already proved in our course on Physics that there cannot be an infinite magnitude to have an infinite force, and also that it is impossible for a thing to be moved by a finite magnitude during an infinite time. But the first mover causes a motion that is eternal and does cause it during an infinite time. It is clear, therefore, that the first mover is indivisible and is without parts and without magnitude" (Physica, 267b16-25). This definition of the First Mover can share with Plato's "soul" the image of or model of the geometric point.

²Claghorn, Aristotle's Criticism, p. 13.

³Physica, 216b6.

⁴Aristotle asks, "why need we assume a place for bodies over and above the volume of each?" (Ibid., 216b13).

⁵Ibid., 208b8-10; Ross observes, "Further, the typical locomotions of the elementary natural bodies—namely, fire, earth and the like—show not only that place is something, but also that it exerts a certain influence" (Ross, Aristotle, p. 85). Taylor agrees with this thesis and says, "Aristotle, in fact, attributes to the different regions of 'absolute' space a sort of power of 'attracting' different kinds of body" (Taylor, Commentary, p. 665). Space and place had teleological significance.
No place is infinite in magnitude, although as in an arithmetical series, there are an infinite number of potential places.\(^1\) Aristotle avoids having to raise the question, "What is the place of the Whole or All?," by giving the All "interdependent" rather than "independent" existence. As "every body is in place, so, too, every place has a body in it."\(^2\)

Aristotle's concept of place, and thus of space, is complex and allows numerous interpretations. Because Aristotle holds a concept of immovable place, Taylor concludes that Aristotle "thinks of extension first and foremost as a 'quantity' of something, in fact as bulk, not as a complex of relations of situation. Cubic capacity, not direction, is the capital thing with him."\(^3\) For this reason Taylor calls Aristotle's view of space "naive" because he seems to hold a limited "absolute space" divisible ad infinitum. But to call Aristotle's space 'absolute' is not to present the whole picture. Consider the implications of the following statements:

1. "First then we must understand that place would not have been thought of if there had not been a special kind of motion, namely, that with respect to place."\(^5\)
2. Place is "the boundary of the containing body at which it is in contact with the contained body."\(^6\)
3. Furthermore, "If a body has

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\(^1\) *Physica*, 206a25-29; 211a17-211b5; cf. also Claghorn, *Aristotle's Criticism*, p. 12.

\(^2\) *Physica*, 209a26-27; cf. also 205a10.

\(^3\) Taylor, *Commentary*, p. 674.


\(^5\) *Physica*, 211a11-12.

\(^6\) *Ibid.*, 212a5-6.
another body outside it and containing it, it is in place, and if not, not.\(^1\)

In these three statements Aristotle has put forward basic "relative" or "relational" concepts. (1) Place or space (like time) is relative to and related to motion. (2) Place is primarily a "boundary" of the contained body (whereas the volume is within the boundary); the "boundary" concept of place corresponds to the "boundary" concept of the "now" in time,\(^2\) in which the now is a relational concept which is relative to "before" and "after;" place as boundary is a mathematical or geometric concept which is relative to the container and the contained. (3) Place or space is a valid concept only in reference to two bodies. Place cannot be determined by one set of co-ordinate points. Relativity theory, however, does not presuppose the distinction of "container" and "contained," but is satisfied to relate two bodies which may share a common container.

These three concepts, in addition to Aristotle's insistence that place is related to body or matter, are all elements of a Relational concept of space. The absolute or volumetric character of Aristotle's place is due to

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\(^1\)Ibid., 212a31.  

\(^2\)Ibid., 220a21-23; Heidegger also concludes that entities are "closed round [umschlossen] by the extended boundaries of something that is likewise extended" although we must deny that "Dasein has any such insideness in a spatial receptacle;" but he maintains that there is a "kind of spatiality which is constitutive for Dasein" [Martin Heidegger, Being and Time, Trans. John MacQuarrie & Edward Robinson, from the 7th ed., in the series, The Library of Philosophy and Theology (London: SCM Press Ltd., 1962), p. 134]. Cf. also pp. 51, 125 ff., "Space and Dasein's Spatiality;" Heidegger seems to suggest that the being of space stands somewhere between the space in which the world exists, and "Being-in-the-World."
his division of bodies into two classes, container and contained; the "container" concept, as a vessel contains water, seems to be volumetric; but for Aristotle place is not so much a container as a boundary between the container and the contained. On this basis Taylor should have seen that Aristotle's place involves not only "cubic capacity" (Volumetric Space), but also "direction" (Relational Space). Place itself must be a relational concept—once place is determined only in reference to others—in this way Aristotle's "boundaries" are established.

Aristotle very explicitly does not allow any volumetric space to exist independently of matter, which, perhaps more than for reasons of economy, brings Aristotle to conclude that there is no space beyond the outermost sphere of the All. The place of the sphere is simply defined by its volumetric limits relative to its own parts. If one objects that we need an external reference point to give the sphere positional place, then Aristotle would admit that the All or Whole is not actually in a place. Furthermore, the All does not need a place because only movable bodies have place, and the sphere is not movable. Aristotle's "receptacle" is

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1 Aristotle's analysis of "causes" leads him to postulate the Prime Mover, who is beyond the Sphere. Mure adds, "Yet the prime mover, being not in space or time, clearly does not operate by contact. Aristotle answers that God moves as the object of love and desire" [G.R.C. Mure, Aristotle (London: Ernest Benn Limited, 1932), p. 88].

2 Physica, 211a12-16; 212b15-22; Aristotle says, "For not everything that is is in place, but only movable body" (Ibid., 212b27-29). This definition had impossible consequences for the doctrine of the Ascension of Christ as St. Thomas Aquinas later attempted to work it out.

3 Taylor concludes, "It follows that the whole ὅπως, as having nothing outside its circumference, does not properly 'occupy space' at all" (Taylor, Commentary, p. 674).
not so much an absolute receptacle as something composed of an infinite potential variety of relative, related, limited receptacles, but the actual variety of places at any instant is limited to the constant volume of the whole or All.

In conclusion, then, Aristotle's basic concept of space as place, the boundary or extension between container and contained, has both Volumetric and Relational concepts within it which can be applied with some success when attempting to determine the position or place of a boat on a river, that is, when considering limited volumes and relations, but meets with difficulty when the question is raised, "What is the place of the All?"

3) Aristotle's Concept of Time—the Number Produced by a Moving Now-Point

Aristotle's view of time is perhaps less difficult to understand than his view of space, and seems closer to Plato in many ways than does his view of space. Aristotle does not directly identify time and celestial motion, as Plato apparently does,¹ but rather suggests that time is "neither movement nor independent of movement"² of any variety, celestial or otherwise; it is the "number of motion in respect of 'before' and 'after'."³ This definition has to be amended, however, because things at "rest" also appear to be in time; consequently "time is the measure of motion and rest."⁴ That which is subjected to perishing and becoming exists in time; in fact Aristotle says "time is by its nature the cause rather of decay, since it is the number of change, and change removes what is."⁵ This idea of change suggests that Aristotle's view of "motion" was originally a biological view

²Physica, 219a1.
³Ibid., 219bl.
⁴Ibid., 221b20-22.
⁵Ibid., 221bl-2; 222b19-21.
which later gained teleological significance.\(^1\) We measure
time by movement and movement by time "because they define each other;"\(^2\)
(this is a good statement of the relativity and interdependence of time, space
and motion for physics). But the velocity of motion may vary, whereas time
may not.\(^3\) A regular motion is needed to measure time by numbering motion of
"before" and "after."\(^4\) And "regular circular motion is above all else the
measure, because the number of this is the best known."\(^5\) The circular
movement of the sphere or celestial bodies is nature's best clock, and
consequently "even time itself is thought to be a circle."\(^6\)

The parallel with Plato is that the Demiurge simultaneously created
time and the circular motion of the heavenly bodies to introduce harmony,
i.e. regularity into the universe. Aristotle is not clear concerning the
reason, but he is convinced that time is regular, neither faster nor slower.\(^7\)
He denies, however, that there was or will be a "time" when there was no

\(^1\text{Cf. Matthiess Schramm, Die Bedeutung der Bewegungslahre des Aristotles für seine beiden Lösungen der zenonischen Paradoxie (Frankfurt-am-Main: Klostermann, 1962).}\

\(^2\text{Physica, 220b15-16; 223b14-16.}\

\(^3\text{Ibid., 219b14-18.}\

\(^4\text{Ibid., 219b1-2.}\

\(^5\text{Ibid., 223b19.}\

\(^6\text{Ibid., 229b29.}\

\(^7\text{Ibid., 218b14.}
The conclusion that time is regular or uniform must be the result of external observation, because man's psychic perception or intuition of time is irregular; therefore man needs an external measure of time. Yet even in the dark man knows time passes because "movement takes place in the mind." 

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1 In *Physica* 151b10—28 Aristotle argues that both time and motion are eternal. Because time and motion are so closely related by Aristotle, one would expect that the eternity of one would imply the eternity (infinity) of the other. Benardete offers a compelling argument that Aristotle's argument from motion for the existence of a Prime Mover is complemented by a similar, but independent argument from time. He states that argument thus: "there must be an eternal substance. Why? Because, otherwise, all substances might perish; but that is impossible. Why? Because there must always be substances in motion, and there must always be time. Why? Because time cannot perish. Why? Because perishing entails an afterwards—a time when the perished entity no longer exists—and if time were to perish, then there would be an afterwards—a time—when time no longer exists, which is absurd. But not only must there always be time, but there must also always be substances in motion. Why? Because the passage of time is unintelligible apart from moving (or changing) substances. Hence not all substances are perishable: there must be an eternal substance" (Jose' A. Benardete, "Aristotle's Argument from Time," *Review of Metaphysics*, Vol. 12, p. 362). Newton would agree with Aristotle that Time is infinite, not because the opposite would be logically contradictory (a priori), but because time is a consequence of God's existence. The universe for Newton, however, is not eternal.


3 *Ibid.*, 219a5. Cushman comments, "Aristotle was at the threshold of approaching a nonphysical and, possibly, teleological view of time; but he makes nothing of his observation concerning motion in the soul. He reverts to the exteriorized standpoint and proceeds to give a physical account of time" (Cushman, "Greek," p. 259). It seems likely that Aristotle, like Plato, thought that the moving "now-point" essentially explained the internal as well as external experience of time. Cf. Heidegger, *Being and Time*, pp. 472—80, for a discussion of "now" as related to "within-time-ness."
The difference between physical as opposed to psychological time may be part of Aristotle's difficulty with the "now." Conscious man is aware of a "now," yet if he is in the dark he may not know exactly what "now" it is. For Aristotle "the 'now' measures time" because its motion gives time its linear countable character in terms of "before" and "after." The "now" corresponds to the moving point of a body, and it is this moving "now-point" which makes time continuous. Here the parallel between Aristotle and our interpretation of Plato is obvious. We said that Plato's heavenly bodies represented a moving "now-point," a moving "timeless present;" Aristotle's view was more general. Any body in motion represents a moving "now-point," but celestial motion is the most countable and continuous.

It is the character of the now-point in time which troubles Aristotle and makes him doubt time's existence. There are two parts to time, the past which has been and is not, and the future which is going to be and is not. Before and after are divided by the now-point. But the now-point is

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2. Ibid., 219b16-17.

3. Aristotle's logic is, "Because the magnitude is continuous, the movement too must be continuous, and if the movement, then the time" (Ibid., 219a11-12).

4. Aristotle sees a clear parallel between geometric "points" and "moments" (nows); in speaking of motion he says, "there corresponds to the point the body which is carried along" (Ibid., 219b16); and "the 'now' corresponds to the body that is carried along" (Ibid., 219b23). Thus, in correlating time and motion, "now" and "point" both correspond to "the body which is carried along;" therefore we conclude that time is represented by a moving "now-point" and is "like the unit of number" (Ibid., 220a3). There seems to be a high correlation between Plato's image of eternity as a moving now-point-unit-planet and Aristotle's moving now-point-unit-body. Cf. also *Physics*, 220a9-11;16-19.

5. Ibid., 217b31-33.

6. Ibid., 217b34.
not itself time, it is not a "part" of time. The reason is rooted in Aristotle's belief that a geometric line is not composed of points, (as time is not composed of instants), and that a point does not have place.\footnote{Ibid., 231a24; 230a18-20; the most serious objection that can be raised against our moving now-point model is that for Aristotle a point is "fixed" (Ibid., 227a12).} The conclusion that the now-point is not part of time, which logically follows from Aristotle's basic definitions of point, unit, moment, line, divisibility and their various relations to number, motion, and infinity, has the basic difficulty that the now-point which seems to be the most real aspect of time in experience is not "part" of physical time.\footnote{Ibid., 212b24.} The "now" corresponds to Plato's "\[\]", the apparent moving image of eternity in becoming. But for Aristotle the "now" is primarily a boundary between past and future as place is the boundary between container and contained.\footnote{Ibid., 218a3-218a30; Aristotle says, "For we lay it down that one 'now' cannot be next to another, any more than point to point" (Ibid., 231b6-8). Cf. Evans, "Aristotle, Newton," p. 548.}

He can speak about the "now" that has ceased to exist; but since neither "before" nor "after" exist, the only aspect of time to which Aristotle can give the character of existence is the number of the motion of the now-point. He was committed to a "continuous" view of time, but the "now" character, which seems serial, suggests an "atomic" time.\footnote{Physica, 218a3.} Yet the continuous character of time had to be maintained because the "now" corresponds to the moving

\footnote{Taylor, Aristotle, pp. 97-98.}
body. No instantaneous "now" could make us aware of time's moving character, or of any motion, as Aristotle admits on inspecting Zeno's arrow.  

It is characteristic of Plato's Eternal that "was" and "will be" do not apply; and "is" is rather the proper language to speak of eternity; and "is" is the aspect of eternity most like time. Aristotle, however, in treating the "is" character of time says, "the 'now' is an end and a beginning of time," the basis of his "boundary" definition of the "now."

Another difficulty in understanding Aristotle is that he does not distinguish as clearly as does Plato between time and eternity. He seems to say that time, like motion, will be eternal (meaning infinite). Aristotle does not believe that rectilinear (straight line) motion is infinite or eternal because it would have to stop when reversing its course. But the circular motion of the heavens could be and is eternal (infinite), by the implied reasoning that what never stops moving is eternal. Von Leyden says that "Aristotle wished to distinguish between eternity and time and that by 'eternity' he meant what as such is not in time, either because it always exists or because, like Aion, it embraces all time." The heavens are

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1Physica, 219b22-25.  
2Ibid., 239a30-23b9.  
3Ibid., 222b1; cf. also De Caelo, 279a27.  
4Aristotle asks, "Will time then fail? Surely not, if motion always exists" (Physica, 222a29). Cf. also Ibid., 267b24 on the "eternity" of motion.  
5Ibid., 263a1-3. (In Aristotle's spatially finite world any continuous linear motion would eventually reach the limit of the outer sphere).  
6Ibid., 267b18-25.  
eternal in the former sense, while beauty, the rational soul, and the Prime Mover, are examples of the eternal in the latter sense.\(^1\) It is difficult to be sure that Plato held two types of eternal. Of course the outer sphere of the All offers in each case (Plato's Animal, Aristotle's Motion), the obvious link between time and eternity, between Becoming and Being, or between Relational and Volumetric Space. Aristotle's container, as was Plato's, was spherical. It represented the outer-limits within which movement takes place. Likewise for Aristotle "Aion is a container and infinite time the contained."\(^2\) Thus the relation of Space and Time to the Sphere and the Eternal appear to correspond to the contained and the container. The Eternal-Sphere is the container of Time-Space.

Von Leyden regrets that Plato and Aristotle were committed to circular motion, but concludes that parts of Plato and Aristotle come "very near certain statements of modern kinematic relativity."\(^3\) On the other hand, except for the fact that the outer sphere was thought of as a hard shell, the function of the Eternal-Sphere has many parallels with Newton's two distinctions of absolute and relative space and time. Aristotle's difficulty with the "now" and continuity was to be solved to quite an extent by the calculus of Newton and Leibniz.\(^4\)

Claghorn and Von Leyden both agree that Plato and Aristotle are very

\(^1\)Von Leyden, "Time," p. 46; cf. also Metaphysics, 1072b29.

\(^2\)Von Leyden, "Time," p. 46.

\(^3\)Ibid., p. 52.

close in their understanding of Time and Eternity.¹ The basic unity of their view of time is that time is directly related to motion, and despite the fact that Aristotle dislikes a geometrical or mathematical cult like that practised by the Pythagoreans, he admits with Plato that time can be known by the number of motion. The numerical character of time as developed by the Greeks is the outstanding tool given to science in exploring nature. As number, time can be considered homogeneous with other countable things such as space, and treated in a single mathematical equation.

Greek time is definitely wed to motion, whether external as with the heavens, or internal as with a movement in the mind. The concentration of men such as Bergson on the concept of "duration," and the relation between the internal experience of time and memory,² have yet to demonstrate that time can really be divorced from change or motion. Perhaps one of Aristotle's most helpful insights was that time and motion measure (define) each other. Aristotle is aware of the internal problem of time, it is "worth considering how time can be related to the soul" and "whether if soul did not exist time would exist or not."³ But he does not linger with these questions. The rational soul can count,⁴ thus apparently knowing time; and soul does

¹Claghorn, Aristotle's Criticism, pp. 84-93; cf. also Von Leyden, "Time," p. 35-52.
²Bergson, Time and Free Will.
³Physica, 223a16-22.
⁴Ibid., 223a22-29. Is it the "now" which the soul knows by counting? No, for the now cannot have a number. The soul counts between several nows, between A and B, B and C (Ibid., 222a10-32).
exist, so we are not pressed to answer whether time would exist if soul did not. Since time is a kind of "number" we might suspect that Aristotle holds a rational, subjective view of time, but Wieland warns that the counting aspect of the soul is in "keineswegs ein Beispiel für eine subjektivistische Zeitauffassung." Wieland's reason is that Aristotle pointed to two kinds of number, what is counted and that with which we count; time is the former.

Perhaps one implication of Aristotle's view of time is that time, like space or place, is static. It is the thing counted, the static "before" and "after." The "now" or "is" is reduced to an instantaneous something which corresponds to a moving body, and is like a moving now-point as expressed and experienced by the soul.

Plato's eternity is a timeless present, which we gather is a "now" without before and after. This points to the most basic difference between Plato and Aristotle in respect to time. While for Plato time is the moving image of eternity, the moving now-point of a planet, a movement which proceeds by number and can be counted, for Aristotle time is the number of movement of before and after. It would seem that for Plato time has an essentially "now" character which moves according to number, while for Aristotle time is

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1Wolfgang Wieland, Die Aristotelische Physik (Göttingen: Vandenhoeck & Ruprecht, 1962), p. 316. Taylor supports Wieland's position. "Plato and Aristotle know nothing of Kant's doctrine of the 'ideality' or 'subjectivity' of time." The World is not simply an 'effect' on our minds, it is real (Taylor, Commentary, p. 660).

2Physica, 219b3-8.

3Aristotle's battle with the "now" eventually raised a question which resulted in the psychological term first developed by William James, "the specious present," which suggests that the best model to express the experience of time is more like a saddle back than a knife edge. This is the difference between the time of psychology and of physics. Cf. W.A.C. Dobbs, "The Relation Between the Time of Psychology and the Time of Physics," British Journal for the Philosophy of Science, Vol. 1, pp. 122-137. (Both models are rather static, and perhaps the idea of a "moving wave crest" would be better.)

the number of before and after created by a moving now-point. Plato's time "proceeds according to number," while one might say Aristotle's time is the "number of proceeding." If this distinction is valid, even if too sharply drawn, then Aristotle's concept is essentially static while Plato's is dynamic. Aristotle's "now" is not time, and he prefers to call it a "boundary,"¹ which is again a rather static concept. Thus although both Plato and Aristotle apparently relate time to the dynamic concept of motion, Aristotle's time is rather static in spite of the relation, and perhaps this is one reason he does not draw the distinction between Time and Eternity as sharply as does Plato.

Conclusions

In reviewing the first chapter, we see that the nature of the universe was for the early Greeks a human concern which combined elements of philosophy and theology. The main tools contributed to the study of nature by the Pythagoreans were the science of mathematics and geometry applied to physical reality. Geometry as a "timeless" symbol of reality represented the Real of Plato's epistemology. The world of Becoming can only be known by the "mind" through the timeless forms of Being. The mind is happiest in knowing the "unchanging" Forms.

In terms of space and time, Plato sees first of all an abstracted container of the universe, that which he calls the Receptacle, Volumetric Space. Plato also develops a concept of Relational Space, based on a concept of interdependent triangles as a means of explaining the relative spatial aspect of the world of sense-data. Time for Plato as the image of eternity moving according to number is best represented by the circular fluxion of a geometric

¹ Ibid., 220a21.
point, a celestial now-point; time exists only as an ordering aspect of the universe. Eternity is unlike time in that it is a timeless present with no "before" or "after." The soul is capable of knowing time because the soul moves through the head as a celestial body moves through the Receptacle carving out the orderly numbers of time. But the soul also participates in the rational. Spatial objects are divisible, changeable, and thus destructible. Only the non-spatial, like the geometric point, is permanent. Also, only the non-temporal is permanent, although the process of Becoming or "continuing impermanence" may be infinite.

Aristotle is concerned with the problem of the infinite, and space and time are often thought to be infinite. Both are only potentially infinite, because they can be numbered and/or divided. Aristotle is analytical in his Physica, and he concludes that there is no basis for holding a belief in an actual infinite Volumetric Space; matter is not infinite, and space does not exist apart from matter. Matter is eternal, and its motion in space is eternal because of the existence of a Prime Mover who moves by "affection" rather than direct contact. Aristotle's basic concept of space is place, a concept at once Volumetric and Relational, although it is essentially Relational. Both aspects of space are derivative of the nature of primary matter. Since matter is volumetric and relational, so is space.

Time for Aristotle is much like the time of Plato. It is the number of motion of before and after, or the number of a moving now-point. Motion and time are relative, they define each other, just as place and motion are relative. But whereas for Plato time proceeds by number, for Aristotle time is the number of motion. Thus Aristotle's time is somewhat static.

The basic concepts common to Plato and Aristotle are that space is both
Volumetric and Relational, the first when considered abstractly, the second when considered in relation to sense-data and motion. Geometry and number can both be useful in measuring and knowing space, because they are timeless epistemological tools. Time, like space, and motion, is a feature of the universe of Becoming. If time and space were eliminated, motion and change would cease. But time is not only an agent of change, it is also an ordering device. Time, like space, can be measured and numbered.

D) Eschatological Questions Derived from Greek Space and Time

At this point we shall raise a few questions concerning aspects of eschatology which are relevant to this first chapter. We shall not attempt any systematic treatment at this point, but will only raise questions which will undoubtedly regain significance with Newton. It is important to show, however, in a preliminary way, the types of problems which Greek concepts of space and time, which are basically analytical and scientific, have posed for biblical eschatology.

There seem to be two basic questions which can be raised from which most eschatological problems are derived. They are (1) What is permanent in existence (in God, in Nature, in Man), or What does God intend to be permanent?1 (2) What is the purpose of existence, or What is God's purpose for existence?2 This is the teleological problem. The first question is basically about the nature of existence or being; the second is why being is what it is, or why it is intended to be something other than it is. These

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2 Mascall is concerned with the "Purpose of Creation," (Mascall, Christian Theology, pp. 290-318).
Questions eventually brought forth the concept of design.

The question of permanence is broad and important. Plato raised the question in his introduction to the scope of physics in the Timaeus. He says,

"We must, then, in our judgment, first make this distinction: what is that which is always becoming and is never real? That which is apprehensible by thought with a rational account is the thing that is always unchangeably real; whereas that which is the object of belief together with unreasoning sensation is the thing that becomes and passes away, but never has real being."

For Plato the object of reason is permanent, it has real being. And this implied the permanence (immortality) of the seat of reason, the mind or soul. Geometry, number and logical dialectic were all objects of reason and knowledge because they were not subject to change, they were timeless, they were epistemological tools.

On the other hand, physical reality, organic matter in particular, says Plato, is constantly changing. Spatial divisibility and temporal decay worked hand in hand for destruction, as Aristotle admitted. This then was the way in which the Greek duality of mind and body, eternal and temporal, necessary and contingent, developed. This epistemological method has not only influenced philosophical thought, but it has also been adopted by many Christian thinkers.

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1Timaeus, 27d-28a.

2Munz maintains that the ἐγώ ἐσμαι concept of Exodus 3:14, later stressed in John's Gospel, has been misinterpreted by Jews and Christians to mean "I am Being" in the Greek sense, thus setting God up in contrast to man, causing the barrier between God and man to be God-made, rather than man-made (Peter Munz, "Sum Qui Sum," Hibbert Journal, Vol. 50, pp. 145-50).
In Christian thought there are several aspects of the permanent. The Triune God is permanent; "From everlasting to everlasting thou art God" (Psalm 90:2); "Jesus Christ is the same yesterday and today and for ever" (Hebrews 13:8); the Word of God is permanent; "For ever, 0 Lord, thy word is firmly fixed in the heavens" (Psalm 119:89); "Heaven and earth will pass away, but my words will not pass away" (Matthew 24:35); God's attitude toward man is permanent; "his steadfast love endures forever" (Psalm 136). On the other hand, earth, earthly power and possessions are subject to change and decay; "Do not lay up for yourselves treasures on earth, where moth and rust consume and where thieves break in and steal, but lay up for yourselves treasures in heaven" (Matthew 6:19-20).

What was the Greek understanding of the purpose of existence? Plato thought that God intended the creation to be good, and that man's chief end was to think about the Good, to convert his mind from contemplating objects of Becoming, to thinking about objects of Being.

The biblical purpose for creation must be seen in the light of the Covenant. God not only made the universe, but he agreed to keep it as his own. The main difficulty is that man's sinful nature has caused God's creation to be less than God intended it to be. Salvation is the process in which God repairs the damage man has committed through his revolt against God's Lordship. Redemption involves accepting God's Lordship in Christ. This in turn points to two main foci in the Bible which establish the Kingship of Christ, the Crucifixion and the Resurrection. Here God overcomes man's two main enemies, Sin and Death. It is God's purpose (telos) to restore his Creation, to bring about a New Heaven and a New Earth, as well as a New Man. The first New Man was Christ, the Second Adam (Romans 5:12-21). The
work which God began in Christ on the Cross and in the Empty Tomb he will consummate at the Last Judgment, with the Parousia of Christ and the Resurrection of mankind in the Last Days. Then the company of faithful will become like him.

Within this context of biblical purpose and permanence certain questions become significant. (1) What is the relation between the Greek and Christian concept of permanence? (2) What is the relation between the Greek and Christian concept of purpose? (3) What is permanent for the Christian in terms of space and time? (4) What purpose or space and time serve in the Christian life and hope? (5) Does the Resurrection of the body of Christ imply a permanent spatial existence in God's plan for man? Is this space Relational, Volumetric, both, or neither? (6) Does the Greek concept of a non-spatial eternal existence (in which soul, but not body is saved) suggest that a dualistic epistemology is untenable for the Christian? (7) To what extent could a non-spatial eternal existence be meaningful to man? (8) What is the biblical understanding of the relation between time and eternity? (9) Is the process of change evil, or good, or neutral in biblical terms? (10) Is it possible to experience time without experiencing change? (11) Does the permanence and pre-existent character of Plato's Receptacle conflict with the concept of "creation out of nothing"? (12) To what extent is the

---74---

1For the Greeks, according to Mabbott, "Evil is found only in the world below, the world of time and change" (Mabbott, "Aristotle... Plato," p. 78). The question is thus raised whether process, time and change are themselves good or evil, with the Greek "timeless present" offering the means of escape. But the Christian, according to some of the biblical parables, is encouraged to participate in life. There are serious consequences for the man who fails to invest his talents (Mt. 25:16-17; Lk. 19:20-21).
Greek view of time impossible as a model on which to construct a concept of history? (13) What is the relation between time and space on the one hand, and eternity and heaven on the other? In Plato this is of course expressed mythologically. (14) Does the Greek scientific definition of time as known either by number or order represent the most useful definition for a proper interpretation of biblical eschatology? Is the exact day, the exact hour, of either the First or Second Coming of Christ the most important contribution of time to eschatology? Or is the order of events (relations) more significant? Or is the fact that time allows process its most significant feature? Is God forced to act in the order and number of time? (15) What type of space is implied in the concepts of heaven and hell, the Kingdom of God, the Second Coming, the Last Judgment? (16) Does the permanence of the Word of God, the biblical Word, mean that it is timeless? Kümmel does not think so. (17) What is the spatial significance of the

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1 Cushman contends that the Greeks can develop no idea of history (Cushman, "Greek," p. 257).


3 Martin points out that "Much discussion was devoted, especially by Gerhard, to the number and order of the Last Things" [James Martin, The Last Judgement: In Protestant Theology From Orthodoxy to Ritschl (Edinburgh: Oliver and Boyd, 1963) p. 7]. We shall find this true of Newton.

Ascension of Christ; of the Sacraments? (18) What is the spatial reference of the Holy Spirit? What is the parallel between this reference and the idea of ether? (19) To what extent does any geometric concept of time (either the Greek circle or Cullmann's time-line) do justice to the Christian concept of time? (20) What are the implications of identifying soul and eternity with a geometric point?

These questions are by no means exhaustive, but they do point to the type of eschatological problems which concepts of time and space affect. Most of these questions will need to be considered in reference to the work of Newton.

\[\text{\footnote{Cullmann, Christ and Time, p. 51; cf. also Collingwood, who contends that while a mathematical analysis of nature may not tell us all we would like to know, we shall have to be satisfied not to know "what the world is made of" and simply study its patterns [R.G. Collingwood, The Idea of Nature (Oxford: At the Clarendon Press, 1945), p. 53].}}\]
CHAPTER II

THE LINK BETWEEN THE GREEKS AND NEWTON—RENE DESCARTES

A) Introduction—The Link Between Aristotle and Descartes

We are going to move almost directly from the Timaeus of Plato and the Physica of Aristotle to the Principia Philosophiae of Descartes, after which we will turn to the Principia of Newton. To move from Aristotle to Descartes involves vaulting nearly two thousand years, and thus we will be perpetuating the error, which has too often been followed in the course of scholarship, of all but ignoring early Christian and mediaeval thought. A thorough approach to our problem would involve an investigation which could lead to several volumes which would trace the course of the history of science and of Christian history as they interpenetrated each other up to the time of Newton. The main value of our presentation thus far is that it will offer a fairly definitive philosophical approach to the problem of the nature of space and time which was accepted in a large degree up to the time of Newton. When Isaac Barrow taught Newton’s mathematics class at Cambridge, he included in his lectures a discussion of Aristotle’s concept of time. And we shall see that Descartes had basically accepted Aristotle’s concept of a "filled" space, a concept which Newton rejected in favour of something like Plato’s Receptacle.

In terms of the history of science, Plato, Aristotle and Descartes all held something like a "rationalist" epistemology, although both Aristotle and Descartes were to some extent "experimentalists" or "observers," although not in the degree which we shall find in Newton. Newton rejects Descartes’ "Philosophy" in favour of "Natural Philosophy," so that in a sense when Newton breaks with Descartes he also breaks with the Greeks.
The emergence of the experimental method is of course a complex process; A. C. Crombie in his work *Augustine to Galileo,*¹ has shown that during this period it is impossible to separate the "scientific" and Christian world view. Most scientists were theologians. Lynn Throndike in his monumental eight volume work *A History of Magic and Experimental Science*² has shown that the experimental method of science germinated in very primitive forms, including magical rites, and that it was only through the passage of time that magic and experimental science really became separated at the end of the seventeenth century. Science developed as a result of man's desire to control and manipulate his environment, as well as a result of man's desire to discover the unknown. Science certainly received a new stimulus in the west about the time of the Persian scholars Avicenna (980-1037 A.D.) and Averroes (1126-1198 A.D.), who greatly influenced not only scientists such as Robert Grosseteste, whom Crombie sees as one of the first experimentalists,³ but also the master Roman Catholic Theologian St. Thomas Aquinas.

The Persians revived interest in the Greeks. Historians of science have spent a considerable amount of time deciding who in the middle ages is the "Father of Modern Science," or at least the father of the Copernican-Galilean revolution. Roger Bacon (a pupil of Grosseteste), Duns Scotus and William of Ockham are always mentioned. Perhaps two in particular who have received recent attention are


Nicole Oresme (c. 1310?–1382 A.D.) and Nicholas of Cusa (1401–1464 A.D.).

E. Gilson says that Oresme "clearly anticipated the law of falling bodies, the diurnal movement of the earth, and the use of co-ordinates." D. Durand in "Nicole Oresme and the Mediaeval Origins of Modern Science" has argued that Oresme is in many respects the precursor of Copernicus, Galileo and Descartes. Oresme is also a figure who represents a mixture of the magician and experimental scientist in Thronike's sense.

Oresme is also interesting in that he had a Platonic interest in geometry, but he went beyond Plato in his attempt to relate the geometry of the world of being to the world of becoming. And his geometry led him to be interested in the problems of space, time and motion. He debated over the problem of "the indivisible nature of points," and he eventually adopted a practical atomism like that of Democritus.

It is interesting how his concern for geometry and space led him to suggest a relation between space and God much like that which we shall find in Newton. Crombie has shown that Oresme put forward the idea that absolute motion could be defined only with reference to an immovable infinite space, placed beyond the fixed stars and identified with the infinity of God, but he adhered to the theory of forma fluens to explain motion.

Ernst Cassirer has given Nicholas of Cusa a pivotal place in the history of science, and in fact he suggests that in terms of his epistemology

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4 Durand, "Oresme," p. 179.
5 Crombie, Augustine, p. 250.
and his humanistic and scientific concerns he is to be seen as one of the fathers of the Renaissance. This is the basic thesis of Cassirer's work, The Individual and the Cosmos in Renaissance Philosophy.¹

The history of the church up to the time of Copernicus had been a process of integration of Christian and Greek thought. "The theology of the second and third centuries," according to P. Schaff, "was mainly apologetic against the paganism of Greece and Rome, and polemic against the various forms of the Gnostic heresy."² T.F. Torrance adds that Judaism was also a major problem "with its insistence upon law by which the Church was enormously influenced in spite of St. Paul."³ Christian eschatology stood in tension between an "other worldly" and a "historical" eschatology. For the first two centuries a good portion of the church held a "millennial" or historical eschatology which was based on the belief in the second coming of Christ, a literal return of the ascended Christ to earth to establish his kingdom. But as time passed, as the "parousia" was delayed, the church fathers began to develop along side their historical eschatology a futuristic other worldly eschatology, a heavenly eschatology.⁴ Both of these elements are built into the biblical material, but the influence of Jewish

⁴ Strictly speaking the "eschaton" is the end beyond which history does not continue, and could be applied strictly to the "Second Coming of Christ" and the "Last Judgment." But as W.A. Whitehouse has pointed out, "eschatology" has come to be something of an "umbrella term" in modern debate, and we're using the term throughout this paper in a fairly broad sense [See W.A. Whitehouse, "The Modern Discussion of Eschatology," Eschatology: Scottish Journal of Theology Occasional Papers No. 2 (Edinburgh, Oliver and Boyd Ltd., 1957), pp. 65-96; see especially p. 72]. Cf. also W.J. Mauel, "Futuristic and Realized Eschatology in the Earliest Stages of Christianity," Trans. P. Kjeseth and C. Klick, Journal of Religion, Vol. 43, pp. 303-314.
thought tended more toward the historical, and Greek thought toward the heavenly interpretation of eschatology. These tensions are evident in the work of all the early fathers—the Clements of Rome and Alexandria, Justin Martyr, and Irenaeus, with Origen tending more toward the Jewish—Weltanschaung—but both Jewish and Greek thought are apparent in all. This was natural for the Christian faith was brought from the Jews to the Gentiles. The Gnostic heresies usually came from the biblical program such as that of Marcion who thought Luke, the only Greek author in the New Testament, should be the only trusted source for the Gospel. On the other hand there were the strong and extremist proponents of chiliasm, and those behind the Arian Christology, who exhibited Jewish roots together with a philosophic dualism. Newton, as we shall see, attempts to stand on what he believes to be the "Jewish" side of the Christian controversies of the early church.

The really definitive marriage of Greek and Christian thought was performed at the hands of St. Augustine (354-460 A.D.). Augustine was first nourished on Neo-Platonism, and this served him well in both his rational exposition of the Christian faith, and in supplying him with an intellectual as well as religious definition of the human "soul," and his City of God is a synthesis of the Hebrew-Christian view of history with the political idealism of Plato's Republic. Augustine would be a very good starting point for an analysis of the influence of Greek concepts of space and time on Christian eschatology. As we saw time was intimately associated with the "soul" as the "moving image of eternity" in Plato's Timaeus.

And this personal aspect of time served well Augustine's existential theology.
of the type exhibited in the Confessions. But Augustine did not ignore the historical aspect of time, the external aspect, and this was his great strength. The City of God is his analysis of the relation between the kingdom of God on earth and the kingdom of God in heaven, and of the significance of God's providence in history.

Among the greatest Pre-Reformation theologians are St. Augustine and St. Thomas Aquinas (c. 1225-1274). Gilson suggests that with Aquinas, in contrast to Augustine,

Instead of rooting itself in the personal experience of the theologian, theology assumed the shape of an objective exposition and interpretation of the saving truth, as impersonally teachable as any other art or science. It is not surprising that the Augustinian monk Martin Luther should rebel against what eventually became a rather impersonal Scholasticism. Aquinas used the philosophy of Aristotle to support his metaphysical theology, which took a reformed concept of the first principle—Being—as its starting point. And the five Thomistic "proofs" of the existence of God were derived by uniting Aristotelian concepts of Being and Causality, and applying them to the necessary and contingent aspects of reality.

In the second century the astronomer Ptolemy in his Almagest has combined Pythagorean geometry with the order of Being of Aristotle to produce a complex universe of spheres and cycles which could be used to "predict" celestial events. When Aquinas became the established theologian

---82---

1 Cf. Erich Lampey, Das Zeitproblem Nach Den Bekenntnissen Augustines (Regensburg: Josef Habbel, 1960); also Callahan, Four Views, pp. 149–204. Augustine, in his Confessions, book IX deals with time specifically: Callahan shows how intimately time for Augustine, as in Plato, is associated with man's soul. For Augustine "No expanse of time is co- eternal with God," (p. 150); the psychological aspect of time is paramount to Augustine (p. 152).

2 Gilson, Middle Ages, p. 364. 3 Ibid., pp. 364–372.
of the Roman Catholic Church, Aristotle and Ptolemy gained even greater authority, so that by the middle ages, as M. Boes comments

Traditional cosmology involved a comfortable and tidy universe, supported by Aristotelian philosophy, made scientifically effective by the mathematical synthesis of Ptolemy, and Christianised by the scholars of the thirteenth century. Imagination had contrived an orderly series of spheres, one within the other, moving according to divine law, here and there adorned with shining heavenly bodies. At the centre was the Earth, lowly in position and nature, yet dignified as the centre of all and the abode of man; fixed immovably in its place, it was subject to the influences of the ever-widening spheres which surrounded it. First in the terrestrial region, below the moon, came the spheres of the Moon, Mercury, Venus, the Sun, Mars, Jupiter, Saturn; hollow spheres nesting one within the other so that although their radii were large, the outer surface of one touched the inner surface of the next bigger one. Beyond the planetary spheres lay the sphere of the fixed stars; and beyond that again, the ninth sphere of the Primum Mobile.

This hierarchy served to support the whole Aristotelian metaphysical order of being, which moved from the impure earth to the heavenly outer sphere. Life was ordered in a hierarchy as the polity of the Roman Catholic Church was hierarchical. Knowledge moved from the top of the scale—metaphysics—to mathematics, astronomy, and then natural science. This formed what Philipp Frank calls "The Link Between Science and Philosophy." Knowledge, like the hierarchy of the church, and of the celestial universe, moved from higher orders of Being to lower orders of Becoming.

In this context it is interesting to examine the theology of Aquinas, particularly in regard to his treatment of 1) angels, 2) the Ascension of Christ, and 3) the Eucharist. In his "Treatise on Angels" in his Summa

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Aquinas had argued that there were three forms of created substance: 1) the purely spiritual, 2) the purely corporeal, and 3) the "composite" creature, man. 1 Man is a tertium quid between spirit and body, and angels have the same status between God and man. Aquinas says, "Incorporeal substances rank between God and corporeal creatures." 2 Angels are very nearly a replica of God's image because they are "the perfect assimilation of an effect to a cause." 3 Here we have a "biblical chain of being" by which transcendence is achieved gradually rather than immediately. This way Aquinas avoids the infinite separation of Plato's *Nous*.

But the interesting feature about the angels of Aquinas is that these "spiritual beings" are considered in terms of number, place and motion as defined in Aristotle's *Physics*, Book IV. 4 The problem of unity and multiplicity is raised, and even more important, Aquinas is aware of the analogy between the geometric point and the spirit-soul which we found in Plato's treatment of time.

Some who were unable to go beyond the imaginations supposed the indivisibility of the angel to be like that of a point. But they were manifestly deceived, because a point is something indivisible, yet having its situation; whereas the angel is indivisible, and beyond the genus of quantity and situation. 5

Aquinas does not deny that a geometric point is in many ways analogous to an angel, but because an angel is higher in the order of being than a point it does not have to obey the properties of a point. Aristotle's definition of place in terms of container and contained applies only to

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2 Ibid., p. 297.
3 Ibid., p. 297.
4 Ibid., of all of 1. 50.
5 Ibid., p. 297.
the level of being of bodies. Thus, Aquinas continues,

it is not necessary on this account for the angel to be contained by a place; because an incorporeal substance virtually contains the thing with which it comes into contact, and is not contained by it: for the soul is in the body as containing it, not as contained by it.¹

Angels are employed by God to move bodies, as the soul of man controls his body. The difficulty is that Angels are thought to be pure perfect beings, and they therefore should have no need or desire to change place. Furthermore, as with Zeno's paradox of the movement of a point, how can an angel participate in "continuous motion"? Whether the calculus of Newton and Leibniz could have been of value here in an interesting question. An angel, however, only involves himself in continuous motion when moving a body as part of God's ministry, and this does not involve imperfection. But when an angel is travelling for his own purposes he can "all at once quit the whole place, and in the same instant apply himself to the whole of another place, and thus his motion will not be continuous,"² and he will thus avoid the problem of implied imperfection. Angels will be eschatologically important in that God will employ them at the General Resurrection.³

Greek physics and astronomy also raise problems for the ascension of Christ with which Aquinas deals in his "Treatise on Christology."⁴ The ascension poses many problems similar to those raised by angels, but even more difficult is the rational justification for the ascension. After all, the earth, the centre of the universe, is the proper place for a body; why

¹ Ibid., p. 311. ² Ibid., v. 53, pp. 316-17.
⁴ Ibid., Part III, p. 57, p. 126 ff.
should the body of Christ ascend at all? Aquinas answers,

The place ought to be in keeping with what is contained therein. Now by his Resurrection Christ entered upon an immortal and incorruptible life. But whereas our dwelling-place is one of generation and corruption, the heavenly place is one of incorruption. And consequently it was not fitting that Christ should remain upon earth after the Resurrection; but it was fitting that He should ascend to heaven.¹

But the body of Christ does not go willingly; it is moved to heaven by the superior power of his soul. Clearly the fact that Christ's body is not now in its "natural" place creates a great difficulty. But Aquinas intends to be true to the Scriptures, and he goes on to say that Christ ascended through all the spheres and even broke through the outer sphere into a space which for Aristotle did not apparently exist, or at least was not a place. This difficulty is overcome because while ordinary bodies need a place, glorified bodies,

Christ's especially, do not stand in need of being so contained because they draw nothing from the heavenly bodies, but from God through the soul. So there is nothing to prevent Christ's body being beyond the containing radius of the heavenly bodies, and not in a containing place. Nor is there need for a vacuum to exist outside heaven, since there is no place there, nor is there any potentiality susceptible of a body, but the potentiality of reaching thither lies in Christ. So when Aristotle proves (De Caelo ii.) that there is no body beyond heaven, this must be understood of bodies which are in a state of pure nature, as is seen from the proofs.²

Undoubtedly the view here expressed that the ascended body of Christ is not in a place made it easier for Aquinas to develop his doctrine of Transubstantiation, that is, that in the Eucharist the bread and wine are converted to the body and blood of Christ. Calvin of course later rejected the notion that Christ was not in a place, and at the same time he rejected Transubstantiation.³ The Eucharist involves the greatest and

¹Ibid., p. 426.
²Ibid., pp. 434–35.
³See below, Chapter IV, n. 2 on Calvin and "space," p. 344.
central miracle in Roman Catholic theology.

And this is done by Divine power in this sacrament; for the whole substance of the bread is changed into the whole substance of Christ's body, and the whole substance of the wine into the whole substance of Christ's blood. Hence this is not a formal, but a substantial conversion; nor is it a kind of natural movement; but with a name of its own, it can be called transubstantiation.\(^1\)

The fact that the appearance of the bread and wine do not change is explained by saying that the accidents remain the same although the substance is changed; and on this account the miracle has to be accepted on faith, not on empirical evidence.

The period between Aquinas and Copernicus involved considerable intellectual and political change. Gilson has suggested that Ockham's epistemological doubt about the unity of being, together with his political treatises on the limits of ecclesiastical and civil government, paved the way for the Renaissance and the Reformation.\(^2\) Kurd Lasswitz has suggested that from the middle ages to Newton there was a continual tendency in natural science to move toward interest in "variability" and away from "substantiality."\(^3\) Science became less interested in Being, and more interested in Becoming. Specifically, men became fascinated with the problem of motion, which as we saw in Aquinas, is a lower form of reality, only performed by spiritual beings as part of the ministry of God. As Herbert Butterfield has observed,

\(^{1}\)Aquinas, Summa, Part III, l. 75, p. 273.

\(^{2}\)Gilson, Middle Ages, pp. 523-545; Cf also Brian Tierney, "Ockham, The Conciliar Theory, and the Canonists," Journal of the History of Ideas, Vol. 15, pp. 40-70, who says, "Ockham, for his part, certainly saw in the canonists of his own day 'the supported the temporal claims of the Papacy his most dangerous enemies'" (p. 43). "With Ockham we begin to meet again the problem of certitude, soon in Socrates, and soon to be found in Descartes.

Of all the intellectual hurdles which the human mind has been faced with and has overcome in the last fifteen hundred years, the one which seems to me to have been the most amazing in character and the most stupendous in the scope of its consequences is the one relating to the problem of motion.¹

The problem of the notion of the celestial bodies was approached in what appeared to be a radical way by Nicolaus Copernicus, De Revolutionibus Orbium Coelestium (1543), in which it was suggested that the sun should be placed at the centre of the universe. Actually Copernicus followed the method and principles of Ptolemy quite closely, and Norwood R. Hanson has suggested that it is misleading to speak of the "Copernican Revolution."² This theory was put forward, however, as only a mathematical convenience because it made computations of celestial phenomena simpler. But Galileo through his use of the telescope, and through his study of the motion of the tides, suggested that what for Copernicus was only a mathematical convenience was an empirical fact. Galileo was both a mathematician and an experimental scientist, and his astronomical work together with his work on falling bodies resulted in his Dialogo on the Great World Systems (1632).³ The success of Galileo helped pave the way to the observations of Tycho Brahe, and his observations were used by Johann Kepler who then synthesized his famous laws of planetary motion, all of which were extremely important in Newton's final synthesis.


Although the work of Copernicus was at first almost unnoted, as the mediæval world began tocrumble, through the Renaissance, through the development of the experimental method, and through the Protestant Reformation, it is not surprising to find that, as Wolf observes, the works of Copernicus remained on the Roman Catholic Index until 1822.¹

With the development of the New cosmology, the earth was no longer the centre of the universe, the centre of space and time, and the whole Ptolemaic- aristotelian-Thomistic order of Being was shattered. There were no heavenly spheres, and the universe was apparently homogeneous. One place was as good as the next. Furthermore because of scientific method, with Francis Bacon leading the way by defining experimental method (although he did not accept the Copernican universe), there emerged a whole new definition of truth, and in fact Basil Willey has suggested that the key to the seventeenth century is to see how dominant is the search for the nature of Truth.² The Authority of the Roman Catholic and Greek world was questioned. This had tremendous consequences for Christian eschatology, and Luther and Calvin were not enough aware of the issues to save Protestants from the same difficulties, although perhaps Calvin's transcendent eschatology offers a solution to the problem. Luther was not pleased with Calvin, and it has been argued that Calvin never heard of him.³ But what is clear is that the scientific, economic, social, political and religious revolution which accompanied and followed the Renaissance must

² Willey, Seventeenth Century Background.
³ J. Rosen, "Calvin's Attitude Toward Copernicus," Journal of the History of Ideas, Vol. 21, pp. 351-361; J. Ratner replied to Rosen with "Some Comments on Rosen's Calvin's Attitude Toward Copernicus," suggesting that "It is incredible that Calvin never heard of Copernicus" (p. 362) since Luther, among others had heard. Both disagree over the value of the "silence" of Calvin (Journal of History of Ideas, Vol. 22, pp. 552-560).
all be kept in mind when we raise the question, "What was René Descartes attempting to achieve in his _principles of Philosophy_?

**B) Descartes' "Principles of Philosophy"—Rationalism**

We are going now to examine in some detail Descartes' _Principia Philosophiae_ (1644), the work which represents his synthesis of both his philosophy and his natural science. We chose this work because it is the one above all others which came to Newton's attention, and at least in a negative sense caused him to react and eventually construct his own answer to Descartes in his "Mathematical" Principles of "Natural" Philosophy. The very title suggests the underlying break between Descartes and Newton. We shall treat 1) Descartes' Epistemological Metaphysics—Cogito, 2) Descartes' Identity of Space and Body—Extension, and 3) Descartes' Cosmological Synthesis—Vortices.

**1) Descartes' Epistemological Metaphysics—Cogito**

René Descartes (1596-1650) represents a landmark in the history of philosophy; on the continent he influences first Spinoza and Leibniz, and then Kant; and British philosophy also owes much to him, as is evident in the Cambridge Platonists, in Locke, Berkeley, and Hume. Descartes has often been used, as A. Boyce Gibson admits, as a springboard to German Idealism, and he has often been treated as "a mere precursor of Kant."¹ In the process scholars have ignored the debt of Descartes to the Renaissance and the Reformation; but Gibson nevertheless admits that there are good arguments in support of "the prevalent assumption that Descartes was simply a bolt from the blue."² Susan V. Roebuck in fact comments that the work of Descartes was so revolutionary that it provided philosophy with a shock from which it

² Ibid.
shall never recover.¹

But as Gibson is quick to argue, no one who was educated by the Jesuits could completely escape from the past, and we shall see that in spite of Descartes' awareness of the Copernican revolution, he held a basically Aristotelian concept of space. Furthermore, in the very notion of seeking out a first principle on which he could build his physics he was following standard philosophical practice. In spite of his ability in mathematics, Descartes attempted to construct a philosophical metaphysics for his science rather than a mathematical synthesis of the type developed by Newton. Therefore Descartes represents a catalyst between the Greek philosophers, the Scholastics, and Copernican revolutionaries on the one hand, and Isaac Newton on the other. Between Descartes and Newton the break between philosophy and science, which lasted until the twentieth century, can be seen clearly. It has only been with the advent of relativity theory that scientists have once again become philosophers, because it has been seen that the "scientific method" developed by Newton required philosophical examination. Descartes was both a philosopher and a scientist, but he is remembered today chiefly as a philosopher, and this is no accident. Neither is it an accident that Newton is remembered as a scientist, and not as a philosopher. Descartes, in his *Principles*, attempted a cosmological synthesis as brilliant in its scope as Newton's *Principia* which ultimately replaced it. But although Newton rejected much of Descartes' work, he also found much of value.

In a word, the interest which both Descartes and Newton held in common is the problem of "certainty." How can one obtain certain knowledge? Descartes as a Roman Catholic who had witnessed the condemnation of Galileo,

and the fruits of the Renaissance and Reformation, was in a position to ask himself what was indeed certain. Science had by no means succeeded in separating truth from superstition. Gibson notes that during the seventeenth century

...Kepler (Wallenstein's Bohemian compatriot) kept an astrological diary, and was sustained in his immense labours by a Pythagorean mysticism of numbers and harmonies; that Newton, much later, embarked on a mathematical exposition of the Apocalypse which he valued more highly than his discovery of gravitation. It is evident that the renewed interest in nature required the pruning-knife of a stern logic to cut away the hybrid growths of a mystical materialism.¹

Gibson undoubtedly enjoys mentioning the "scandal" of Newton's apocalyptic work, but little does Gibson realize that if Newton had succeeded in this work he would have given the Christian faith a far greater ground of "certainty" than does Descartes' method of doubt, as we shall eventually see. But generally it is true, as Thorndike in his History of Magic and Experimental Science has shown, ² that a "pruning-knife" was needed in the situation which Descartes faced. Skepticism has always been a good editor, as Descartes pointed out in a letter to Abbé Picot, which served as a preface to his Principles. Descartes said,

The first and principal philosophers whose writings we possess are Plato and Aristotle, between whom the chief difference is that the former, following the steps of his master Socrates, cordially confessed that he had never yet been able to discover anything certain, and had limited himself to the setting down of the things that seemed to be probable, for this end adopting certain principles whereby he tried to account for other things. Aristotle, on the other hand, had less candour, and although he had been Plato's disciple for twenty years, and possessed no other principles than his master's, he entirely changed Plato's method of stating them, and proposed them as true and certain although there was no appearance of his having ever held them to be such.³

¹Gibson, Descartes, p. 32.
Thus Descartes believes he stands in the best possible philosophical tradition when he says in his first principle "That in order to examine into the truth, it is necessary once in one's life to doubt of all things, so far as this is possible."¹ This principle is of course the introduction to a synthesis which he had explained in previous works, especially his Discourse on Method (1637), and his Meditations on First Philosophy (1641). Descartes is seeking for a firm foundation on which to rest his philosophy and his science, and he seeks out this foundation by doubting everything "so far as this is possible." Descartes is skeptical that it is possible to doubt everything, and in fact, he will eventually discover one thing which he believes cannot be doubted, and that will be his first principle.

Here Descartes is very traditional, for he shares with Aristotle on the one side, and Bacon on the other,² the anatomy of a tree to explain

¹Descartes, Principia of Philosophy, Haldane (ed. and trans.) Vol. I, p. 219. A standard Latin translation of Descartes' Principles can be found in Oeuvres De Descartes, (ed.) Charles Adam and Paul Tannery (Vol. I-XII, Paris: Leopold Cerf, 1907-1910), Principia Philosophica, Vol. VIII, 1905, pp. 5-343. The principles are divided into four parts, and each part is subdivided into numbered principles. Thus we can refer to the first principle as I, 1. We shall be using two English translations of the Principles, neither of which separately or together is complete. We shall use the Haldane rendition whenever it is available, otherwise we shall use Descartes: Philosophical Writings, (Ed. and Trans. by Elizabeth Anscombe and Peter Thomas Geach, Edinburgh: Nelson, 1954). Only about one third of the Principles are translated between these two editions, but most of our material will be found translated. When neither translation is available we shall refer to the Latin edition in Oeuvres. We shall refer to the works in the following shortened form; using our first citation as an example: Haldane (H), I, 1, p. 219. Cited first is the Principles (Prin.), followed by the editor Haldane (h), Part (I), principle (1), page in Haldane (219). We shall refer to the Anscombe translation as (A), and to the Latin in Oeuvres as (Oeu).

the order of being or of knowledge, Frank's "link" between philosophy and science.\(^1\) Descartes explains in his introduction to the *Principles*:

Thus philosophy as a whole is like a tree whose roots are metaphysics, whose trunk is physics, and whose branches, which issue from this trunk, are all the other sciences. These reduce themselves to three principles: one, viz., medicine; mechanics and morals—I mean the highest and most perfect moral science which, presupposing a complete knowledge of the other sciences, is the last degree of wisdom.\(^2\)

Here is the fundamental tenent of the Enlightenment, that once reason has established itself on a firm foundation man will eventually progress in the natural science which will lead to perfection in the moral sciences as well. At this point Bacon and Descartes differed, for Bacon could derive no moral significance from nature; morality is strictly, as McKee points out, derived from revealed religion, although it must be applied to nature. Bacon and Descartes both believe in the unity of the sciences, but "For Bacon the basis of this unity is nature, for Descartes it is the mind."\(^3\)

In these two we see the traditional distinction between the "objective" in science, in the empiricist Bacon, and the "subjective" in the rationalist Descartes. We must be careful not to make too radical a distinction here. A synthesis of these two epistemological poles was attempted by Kant in his concept of the synthetic *a priori* and the concept of "objectivity" has recently been evaluated by M. Polanyi.\(^4\)

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\(^1\) Cf above, p. 83, n. 2.


\(^3\) W. C. McKee, "Unity," p. 34.

\(^4\) Michael Polanyi, *Personal Knowledge: Towards a Post-Critical Philosophy* (London: Routledge & Kegan Paul, 1958); Polanyi finds that scientists have often been deceived into thinking that total objectivity was possible (pp. 5-17). But rather than suggest that Descartes' subjectivism is the proper course, he suggests that "The method of doubt is a logical corollary of objectivism." It believes it will leave behind "a residue of knowledge" (p. 269).
Knowledge is a human activity, and this has not always been kept in perspective. But the question before us is whether we can, with Descartes, arrive "at the knowledge of the truth" by doubting everything.¹ Is doubting the place to begin?

Descartes tells us that doubt is only a tool used to discover the truth, and we are instructed to doubt because our sense impressions often deceive us.² The fact that the earth is round rather than flat, and that the earth moves around on its own axis, rather than the sun around the earth, must have been instances which reminded Descartes of how the senses can deceive. But Descartes even suggests that we might be deceived by what seem to be the obvious truths of mathematics, because we may have been created by a God "in such a way that we shall always be deceived."³ This is a very powerful argument, for once one entertains this thought, one is indeed faced with a deep skepticism. One may well ask how one could succeed in escaping deception if a God intended that man should always be deceived. We are immediately given hope by the fact that we know by "experience" that we have a free will to abstain from drawing any conclusions about the truth or falsity of anything,⁴ and while we may doubt that we have a body,

We cannot in the same way conceive that we who doubt these things are not; for there is a contradiction in conceiving that what thinks does not at the same time as it thinks, exist. And hence this conclusion I think, therefore I am, is the first and most certain of all that occurs to one who philosophises in an orderly way.⁵

Now we are no longer faced with the possibility that an all-powerful deity has created us so that we should always be deceived. The deity made the mistake of giving us a "free will" so that we could choose not to fall into error, and furthermore, there is a "contradiction" in saying that a "doubting" something does not "exist." It might be said that Descartes exists only so long as he keeps doubting; but even more difficult is the fact that Descartes has accepted a priori the assumption that there is a one to one correlation between logical necessity and substantial necessity or reality. This is an important assumption, for this is the basis of his "mechanical" or geometrical world view which he will later develop. The universe must operate according to the laws of logical necessity in order for Descartes' principle to be valid, and of this we have as yet no guarantee.

This principle of cogito, cerno sum leads Descartes to the distinction between mind and body, and thought is far more certain than any of the attributes of body. We can doubt everything, except that we think. But the mind has within itself other [innate] ideas than that of its own existence, such as

The ideas of number and figure; it has also, amongst its ordinary conceptions this, that "if equals are added to equals, the result is equal," and so on. From this it is easy to demonstrate that the three angles of a triangle are equal to two right angles, etc.

But these will be true only if God wills it to be so. Therefore, in order to have mathematical certainty we next turn to an idea which the mind

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1 Dagobert D. Runes (ed.), Dictionary of Philosophy, (Iowa: Littlefield, Adams & Co., 1959); Frederick L. Will on "Necessity" distinguishes between logical, physical and moral necessity (p. 207-8). When Descartes speaks of existence, he refers to his "soul" which is not physical, but is nevertheless substantial, having its appropriate necessity.

2Prin. (II) I, 8, p. 221.

the idea of a Being who is omniscient, omnipotent and absolutely perfect, which is far the most important of all; in it it recognizes not merely a possible and contingent existence, but one which is absolutely necessary and eternal. And just as it perceives that it is necessarily involved in the idea of the triangle that it should have three angles which are equal to two right angles, ... In the same way from the fact that it perceives that necessary and eternal existence is comprised in the idea which it has of an absolutely perfect Being, it has clearly to conclude that this absolutely perfect Being exists. ¹

Descartes here uses a distorted form of Anselm's ontological argument to give assurance of the existence of a benevolent Deity.² Descartes also adds the interesting principle that the duration of life shows the existence of God, for he sustains, perhaps re-creates the universe from moment to moment.³ The God of Descartes is Aristotle's Fi. Cause, and something more. God is not corporeal, and this might lead to contradiction in understanding the idea of the Incarnation. But this does not mean that revealed doctrines are not true—they are simply "beyond the range of our comprehension."⁴ This is important for here, unlike Aquinas, Descartes admits that there is a division between Faith and Reason which cannot be bridged. We simply accept "unreasonable" doctrines on the authority of the church.

We begin to meet Descartes' program for his doctrine of space when he tells us not to argue about infinity; extension is only "indefinite,"⁵ a notion which Newton quickly rejected. Descartes maintains that God alone is infinite, but not in a spatial sense. But although God is infinite and we are finite, that which we know or apprehend clearly we can be certain is

true because otherwise "we should have had reason to think God a deceiver if He had given us this faculty [Reason] perverted."¹ This is essentially Descartes' two-fold program to overcome doubt: 1) he thinks, therefore he exists, and 2) he has a clear idea of a being who must be all powerful, good, and existent, and who could not, by definition, allow us to be deceived if we think rightly. "And consequently all that we perceive clearly is true, and this delivers us from the doubts put forward above."²

We are now free to believe that our a priori conclusions about mathematics are true, although we cannot help noticing that our idea of God was derived from the same necessity as the necessity of mathematical truth.³ This will have further consequences for his physics, for there will be a one-to-one correlation between rational mathematics and physical reality—the universe will be a machine. The mathematical basis of Descartes' a priori has been discussed by L.G. Miller in his article "Descartes, Mathematics and God."⁴ It is due to this a priori starting point that Descartes' argument has been open to the charge of "circularity."⁵

¹Prin. (H) I, 30, pp. 231-32. ²Prin. (H) I, 30, p. 231. ³Prin. (H) I, 14, pp. 224-25. ⁴L.G. Miller, "Descartes, Mathematics and God," Philosophical Review, Vol. 66, pp. 451-65. ⁵H.G. Frankfurt in his article "Memory and the Cartesian Circle," Philosophical Review, Vol. 71, pp. 504-11, has suggested that it is not so much his own existence which is in doubt for Descartes in his memory, and that the latter is the object of his proof, if this is assumed, his argument seems less circular. T.J. Cronin in his article "Eternal Truths in the Thought of Descartes and of His Adversary," Journal of the History of Ideas, Vol. 37, pp. 535-43, discusses the fact that Descartes' "adversary" holds that eternal truths are true independent of God's will, but not of God's knowledge; Descartes in his program of "doubt" or, used this. Miller suggests that the "adversary" may be Suarez.
Once we have obtained our first principle, then we can survey aspects of reality, and we find that the most "general are substance, duration, order, number," which are not greatly different from the categories of Aristotle; Descartes' dualism between mind and body shows that perception, volition, and every mode of knowing and willing, pertain to thinking substance; while to extended substance pertain magnitude or extension in length, breadth and depth, figure, movement, situation, visibility into parts themselves divisible, and such like.1

Matter is basically "volume" or "volumetric." In addition are the eternal truths based on the law of contradiction, which served as the basis of his cogito principle.2 Descartes then considers these various aspects of reality, and concludes that God is the basic uncreated substance, and in fact he only should be called a substance, but as a matter of convention we may speak of two types of created substances—mind and body. Descartes further follows Aristotle with the substance-accident distinction, suggesting that thought is the principal attribute of mind, and extension the principal attribute of body.3 This is extremely important to notice, for as Gibson has pointed out, many have tried to separate Descartes' metaphysics from his physics, but in fact the two disciplines are integrated at many points, and for our purposes, especially at this one important point.4

Footnotes:

1Prin. (II) I, 48, p. 233. J. Julius Baumann in his work Die Lehren von Recht und Mathematik in der neueren Philosophie (Vol. I-II, Lerein: Druck und Verlag von Georg Reimer, 1868); finds that the concept of time, number and order in Descartes is in most respects the same as that of Francisco Suarez (1548-1617) "nur sehr ins . . . . zu gezogen" (Vol. I, p. 103). Baumann suggests that Suarez is the link between Thomistic Hylasticism on the one hand, and the concepts of time, space and mathematics in Descartes, on the other (ibid., Th., I, pp. 1-67).

2Prin. (II) I, 49, II., 78-79.


4Gibson, Descartes, pp. 47-50; after refuting several arguments which try to separate his metaphysics and physics, Gibson says, "we conclude, then, that Descartes was genuinely interested in both aspects of his synthesis" (p. 55).
Body is that which is extended. Mind is not extended. Mind is like a geometric point!

Descartes has very little to say about time, and perhaps this is not surprising, "since time does not have great consequences for "eternal truths," nor for his philosophy. But he does distinguish between duration in general and time which is usually the measure of movement; some attributes "pertain to things" and "others to thought." Duration pertain to external reality, and time to thought, time is a mode of thinking.¹

Other problems such as the relation between pre-ordination and free will, the problem of error, the nature of perception, and the "prejudices" which we acquire in our youth, all concern Descartes in this first section dealing with the Principles of Human Knowledge. In fact Descartes has set forth his position on two of his three main "substances," God and mind, leaving only body [extension] to be considered. He closes Part I with a summary statement of the relation between faith and reason:

Above all we should impress on our memory as an infallible rule that what God has revealed to us is incomparably more certain than anything else; and that we ought to submit to the Divine authority rather than to our own judgment even though the light of reason may seem to us to suggest, with the utmost clearness and evidence, something opposite. But in things in regard to which Divine authority reveals nothing to us, it would be unworthy of a philosopher to accept anything as true which he has not ascertained to be such, and to trust more to the senses, that is to judgments formed without consideration in childhood, than to the reasoning of maturity.²

¹Prin. (H) I, 57, p. 253; Time or duration is not, for Descartes, a substance, as is "extended substance;" we shall see that both Newton's Absolute Time and Space are more "substantial" than matter. Lasswitz observes "Die Natur der Körperlichen Substanz wird gebildet durch die Ausdehnung in die Länge, Breite und Tiefe. Die Zeit, die Ordnung und die Zahl sind keine Substanzen, auch gehören sie nicht zur Körperlichen Substanz, sondern zur den. . . von welcher die Modi (Zustände) sind" (Lasswitz, Atomistik, Vol. II, p. 97).

For Descartes Divine authority means the authority of the Roman Catholic Church. Thus he can be faithful to his faith by supporting not only a dualism between mind and body, but also between faith and reason. This principle will be especially important when he develops his cosmology.

2) Descartes' Identity of Space and Body—Extension

Part II of the *Principles* deals with "The Principles of Material Things." Descartes had suggested that we might even doubt that we have a body, but since our senses convince us that we do have a body, we cannot believe that the beneficent God we discovered in Part I could allow us to be deceived in such a basic perception.

And hence we must conclude that there is an object extended in length, breadth, and depth, and possessing all those properties which we clearly perceive to pertain to extended objects. And this extended object is called by us either body or matter.¹

In Descartes' derivation of the notion of space we see his *a priori* method begin to break down. Certainly Descartes arrives at the notion of "extended objects" through the senses, and thus his idea of "extension" is to quite an extent derived inductively. Descartes hopes that "extension" is a geometric notion by which he can move to the "volumetric" notion of space.

Sensations prove that the body and mind are closely linked, although not identical. Furthermore, although our senses might lead us to think otherwise, the essence or nature of body does not consist in weight, hardness or colour, "but solely in the fact that it is a substance extended in length, breadth and depth."² We must not let experiments or other evidence obscure this definition of body "by prejudices regarding rarefaction and the vacuum."³ Already we have reached the point where Descartes has arrived at an *a priori* definition

¹Prin. (H) II, 1, pp. 254-55.  
²Prin. (H) II, 4, pp. 255-56.  
³Prin. (H) II, 5, p. 256.
of body as extension, and he is aware that experiments tend to suggest there may be other key properties of body, such as weight, or as the "vacuum" suggests, the property of density. Another element which may cause us to question Descartes' definition of body is

that when we conceive that there is extension in length, breadth and depth only, we are not in the habit of saying that there is a body, but only space and further empty space, which most people persuade themselves is a mere negation.\footnote{Ibid.}

This is a fact which Newton found convincing—extension is only empty space, not body. How does Descartes explain rarefaction? When a body is rarefied, an "invisible" body comes in to occupy the "interstices which become greater." As Descartes explains, "For there is no reason which obliges us to believe that we should perceive by our senses all the bodies which exist around us."\footnote{Prin. (H) II, 7, p. 257} This is of course logically true, but such a position undermines the possibility of experimental science. Empiricism cannot test what by definition cannot be perceived by the senses, although for several hundred years the concept of the "ether" was held by science.

Descartes is attempting to construct a definition of body which includes within it a definition of space, for as he says,

Space or internal place and the corporeal substance which is contained in it, are not different otherwise than in the mode in which they are conceived of by us. For, in truth, the same extension in length, breadth, and depth, which constitutes space, constitutes body; and the difference between them consists only in the fact that in body we consider extension as particular and conceive it to change just as body changes; in space, on the contrary, we attribute to extension a generic unity, so that after having removed from a certain space the body which occupied it, we do not suppose that we have removed the extension of the space, because it appears to us that the same extension remains so long as it is of the same magnitude and figure, and preserves
the same position in relation to certain other bodies, whereby we determine this space.\footnote{Prin. (H) II, 10, p. 259; There is not total unanimity as to what Descartes intends by this identification of space and body. Miller approaches the question from the viewpoint of psychology: "He supports this belief not by analyzing meanings but by pointing out that it is impossible to imagine either body or extension without imagining the other" (Miller, "Mathematik," p. 455); Baumann, however, takes the more obvious approach, which we support, that the identification is logical, not psychological. "Das ist die strenge Ausdrucksweise für das Descartes' sche Denken; die reinen Begriffe und die logischen Regeln zusammen bilden die Dinge" (Baumann, Raum, Vol. I, p. 98). Because of this identity space can only be relative (Ibid., p. 99), and the key to the doctrine of space in Descartes is that "denn Ausdehnung von Raum und von Körper sind convertible Begriffe" (Ibid.)}

There is for Descartes a distinction in \textit{mode}, so that space is extension in general, while body is a particular measure of extension. But there is never an occasion on which space can exist without body. Descartes follows Aristotle—we need no more space in the universe than is necessary for the bodies which occupy it. Space is not like Plato's Receptacle. Descartes seems to say that space differs from body in the same way that duration differs from time. Body and time are measured quantities. For Descartes, therefore, "it is contrary to reason to say that there is a vacuum or space in which there is absolutely nothing."\footnote{Prin. (H) II, 16, p. 262.} It is contrary to reason [logic] because of the \textit{a priori} identification of space and body as extension, but an empiricist would have to ask, is a "vacuum" contrary to nature?

Descartes then goes on to explain, using a "vessel" model of space, what would happen if all the body were removed from a particular vessel.

And therefore, if it is asked what would happen if God removed all the body contained in a vessel without permitting its place being occupied by another body, we shall answer that the sides of the vessel will thereby come into immediate contiguity with one another. For two bodies must touch when there is nothing between them . . . for distance is a mode of extension and without extended substance it cannot therefore exist.\footnote{Prin. (H) II, 18, p. 263}
Having by definition equated extension and body, this of course must be true. To speak of removing all body from a vessel is to say at the same time that all extension is removed. Descartes does not mention one problem created by his vessel analogy. He will soon maintain that the "extension of the world is likewise indefinite;"¹ to suggest that the universe is like a vessel with "sides" suggests that the universe is definite in extension. We doubt that Descartes can apply his "vessel" model to his indefinite universe with logical consistency.

What Descartes has done is to give an essentially geometric definition of "extension" to both space and body. This will be a great convenience, of course, in his attempt later to show that the universe is rational, and mechanical. But his geometric logic also leads him to say that it is impossible for atoms to exist because anything which is extended "we can divide in thought," and what can be divided in thought God can divide if he so desires.² Descartes' geometric definition of matter leads him to conclude that the universe is homogeneous. All the variety in the universe depends on motion, and because the universe is completely full of bodies there is a complete circle of bodies moving together.³ But this circular movement demands a practical atomism; there are particles in the universe, although in theory they will always be divisible.⁴ Descartes follows Aristotle and Aquinas in saying that God is the First Cause of movement, and God always retains an equal amount of motion in the universe. The machine moves at the same speed always.⁵

Why should Descartes search for a "principle of the law of conservation of energy?" Descartes explains that

¹ Prin. (H) II, 21, p. 264.  
² Prin. (H) II, 20, p. 264.  
⁴ Prin. (Oeu) II, 34, pp. 59-60.  
⁵ Prin. (Oeu) II, 36, pp. 61-2.
should in himself be unchangeable, but also that his operation should occur in a supremely constant and unchangeable manner. Therefore, apart from the changes of which we are assured by manifest experience or by divine revelation ... we must not assume any others in the works of God, lest they should afford an argument for his being inconstant.

This notion of God's immutability is right at the heart of Descartes' rationalism. This is his guiding principle in all of his metaphysics and physics. He is seeking for the constant, and the rationality of the law of contradiction, and the principles of geometry derived from it, are the foundation of the universe. Descartes immediately moves on to something, which foreshadows Newton's three Laws of Motion, which Descartes calls "Laws of Nature." Descartes says,

From God's immutability we can also know certain rules or natural laws which are the secondary, particular causes of the various motions we see in different bodies. The first law is: Every reality, in so far as it is simple and undivided ... never changes except through external causes .... A moving body, so far as it can, goes on moving.

This is the law of inertia in seminal form, and for Descartes it derives not from observation of the behaviour of bodies, but from God's immutability. Descartes' second law suggests that ordinary motion is in a straight line, and his third deals with bodies in collision, which later became Newton's principle of "action and reaction." Descartes concludes Part II by saying that he does not allow any principles in physics other than those of geometry or mathematics, because all natural phenomena can be explained mathematically. Space and body have been given almost identical definitions—they are extension in three dimensions. They are volumetric, and geometrical.

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1Prin. (A) II, 36, p. 215.  2Prin. (A) II, 37, p. 216

3Prin. (Oeu) II, 39-40, pp. 63-65; Descartes includes a diagram of a sling to illustrate the relation between centrifugal and centripetal force, which of course raises the question, What keeps the planets in orbit around the sun?

4Prin. (Oeu) II, 64, pp. 78-9.
3) Descartes' Cosmological Synthesis—Vortices

At this point there is a radical break in the Principles. In moving from Parts I and II to Part III we move from philosophy to science, although there is of course continuity between these sections. His doctrine of "extension" will have normative consequences for his physics. Part III concerns the "Visible World," and in fact it is a cosmological synthesis. Descartes moves from the roots of metaphysics to the trunk of physics and its various branches, astronomy being the next in order. Part IV concerns "The Earth," and apparently Descartes intended to write a fifth part on plants and animals, and a sixth part on man, although these were never included. We shall be mainly concerned with Part III, for it is Descartes' attempt to be a faithful Roman Catholic and a faithful scientist, in light of the Copernican revolution.

Descartes begins by telling us of the place of experiments in natural philosophy. He says,

For an investigation of causes, I here present a brief account of the principal phenomena of nature. Not that we should use these as grounds for proving anything; for our aim is to deduce an account of the effects from the causes, not to deduce an account of the causes from the effects.

We are warned not to try to prove the conclusions of Parts I and II from experiments, but rather we are simply to see how these metaphysical causes work themselves out in nature. This is Descartes' rational scientific method. His interpretation of nature has already been determined by his a priori concepts; the phenomena of nature will be useful, but only to discover the consequences of the a priori. Descartes uses the deductive rather than inductive method or at least so Descartes hopes.

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2Prin. (A) III, 4, p. 223.
The key cosmological problem is whether the sun or earth is at the centre of the universe. Descartes finds Ptolemy unsatisfactory, but the hypothesis of Copernicus and Tycho [Brahe] are quite similar, although they do not agree about the exact motion of the earth. Descartes, eager to avoid clerical condemnation, points out that he avoids speaking of the true motion of the earth altogether. Descartes is able to do this because, by his identity of body and space as extension, Descartes posits a plenum or fluid throughout all of space—the heavens are filled. The earth, like all the planets, rests in this fluid, and since by his previous definition of motion as translation from place to place, it follows that the earth is not actually removed from its place in the plenum, but is rather carried along by the fluid. "Philosophically" speaking the earth is at rest, although "relative" to the fixed stars the earth appears to move—we must not let our senses deceive us about the difference between true and apparent motion. How may we understand this planetary motion? What keeps the planet in orbit? We know from the Second Law of Nature that motion naturally tends in a straight line. Descartes then explains his analogy or model of the vortex.

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1 Prin. (Oe) III, 16, p. 85.
2 Prin. (Oe) III, 18, pp. 85-6.
3 Prin. (Oe) III, 19, p. 86.
4 Prin. (Oe) III, 24, p. 89.
5 Prin. (Oe) II, 25-30, pp. 53-57.
Sic itaque sublato omni scrupulo de Terrae motu, putemus totam materiam coeli in qua Planetae versantur, in modum cujusdam verticis, in cuius centro est Sol, assidue gyrare, ac ejus partes Soli viciniores celerius moveri quam remotiores, Planetasque omnes (e quorum numero est Terra), inter eadem istius caelestis materiae partes semper versari. Ex quo solo, sine ulla machinamentis, omnia ipsorum phaenomena facillime intelliguntur. Ut enim in his fluminum locis, in quibus aqua in se ipsam contortis vertit sed facit, si variis festucae illi aquae incumbant, videbimus ipsas simul cum ea deferri, & nonnullas etiam circa propriam centrum converti, & eo celerius integrum gyrum absolvere, quo centro verticeis erunt viciniiores; & semeque quamvis semper motus circulares affectent, vix tenem unquam circulos omnino perfectos describere, sed nonnihil in longitudinem & latitudinem aberrare: Ita eadem omnia de Planetis absque ulla difficilatate possumus imaginari, & per hoc unum cuncta eorum phaenomena explicantur.

Thus Descartes is essentially a Copernican, the planets including "Terra" revolve in a vortex "in cuius centro est Sol." The heavenly fluid is distorted in the same way in which water may form a whirlpool or vortex, and carry objects around in it. As Descartes further develops his cosmology it is necessary to introduce a whole series of vortices, but the basic theory is here. Thus Descartes' a priori identification of space and body as extension has provided him with a convenient plenum which can be used to bring about this imaginative cosmological synthesis, a synthesis, however, which Newton was to destroy basically because he rejected Descartes' notion of space.

This plenum also serves as the conductor of "light," and it also helps explain the phenomena of gravity. In this way Descartes avoided the "scandal" of the Scholastic idea of occult "action at a distance."

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1 Prin. (Oe) III, 30, p. 92.
4 Partick Suppes in his article "Descartes and the Problem of Action at a Distance," Journal of the History of Ideas, Vol. 15, pp. 146-52, suggests that Descartes rejected "action in distance" on a priori grounds, which follows from his definition of extended substance. Also, "in stating the three 'laws of nature,' which are a priori, Descartes commits himself entirely to impact forces and thus to a clear, although tacit, rejection of action at a distance" (p. 149). Leibniz criticized Newton's concept of gravity in his letters to Samuel Clarke on the grounds that good philosophy overthrows attractions; we must beware of "the occult qualities of the schools; which some men begin to revive under the specious name of forces; but they bring us back again into the kingdom of darkness" [H.G. Alexander (ed.), The Leibniz-Clarke Correspondence, (Manchester: At the University Press, 1956): p. 62. Leibniz's Fifth Letter].
Descartes subscribed to a practical atomism, although in theory he was opposed to it.¹ There were three major elements, fire, air and earth; the particles were of the same medium size, but eventually they became worn and spherical from motion. The dust which results from the grinding affect of motion is the substance of stars. The medium sized element is the substance of the fluid of the heavens, and the larger particles form the planets. There is a continual flow from star to planet, to the outer edge of a vortex, into another vortex, and then the motion begins again. The universe is a machine which moves in a fluid consistent velocity, maintained at that velocity by God.

The extent to which Descartes believed the universe was a machine is seen in the following comment.

And it is certain that there are no rules in mechanics which do not hold good in physics, of which mechanics forms a part of species [so that all that is artificial is also natural]; for it is not less natural for a clock, made of the requisite number of wheels, to indicate the hours, than for a tree which has sprung from this or that seed, to produce a particular fruit. Accordingly, just as those who apply themselves to the consideration of automata, when they know the use of a certain engine and see some of its parts . . . [so] I have endeavoured to discover the nature of the imperceptible causes and insensible parts contained in them.²

To describe a tree as a machine indicates the extent to which the mechanical model of the world had replaced the organic model, and the origin of this model does not go back to Newton, as C.E. Raven suggests,³ but rather is

¹Prin. (0eu) IV, 33-42, pp. 220-29; 202, p. 325; J. Grundy in "Descartes and Atomism," Nature, Vol. 173, p. 89, points out that technically Descartes is not an atomist, since he held all particles to be divisible. But this may only have been in the mind of God, and he in fact holds a practical atomism. Lasswitz discusses this atomism, "Feuerelement, Luftelement und Erdelement" (Lasswitz, Atomistik, pp. 65 ff.).

²Prin. (H) IV, 203, pp. 299-300.

³Charles E. Raven, Science and Religion: Natural Religion and Christian Theology (Cambridge: at the University Press, 1955), has suggested that the analogy of the watch used to impose a mechanical universe succeeded because the biological sciences were overshadowed by physics (p.14). Chapter VII of Raven's work is called "Newton and the Age of the Machine," (pp. 125-144), which according to Raven "owed its first preliminary outline to Galileo," (p.127), but certainly a case can be made that Descartes' machine analogy, and his rational metaphysics, should receive much more of the credit than Raven indicates.
something Newton inherited. The way in which Descartes reconciles his science with his religion is shown again in his final principle in which he suggests that he does not hold his theories to be true, but only suggestive, "I affirm nothing, but submit all these opinions to the authority of the Catholic Church," and no one should accept Descartes' principles "unless he is personally persuaded by the force and evidence of reason."¹

C. Observations Concerning Descartes' Philosophy

The implications of Descartes' Principles were far reaching. As Scott has noted,

The Vortex Theory was a bold attempt to reduce the phenomena of the universe to a single mechanical principle, and in spite of its defects it exerted a profound influence upon the progress of scientific thought for the next hundred years or more. By presenting a theory of planetary motions which was at once intelligible and satisfying, Descartes delayed for many decades the acceptance of the correct explanation given by Newton.

Furthermore, Descartes' rationalism succeeded in suggesting a "machine" model of the universe which Newtonian mechanics seemed to verify despite the fact that Descartes' theory was false. Descartes had the insight to see the value of mathematics in science,

But mathematics, despite its enormous scope, is not enough. The habit of painstaking observation, so assiduously cultivated by Descartes' successors, is no less important than mathematical formulation, and it was his failure to recognize this that constitutes the most serious blemish upon Descartes' investigations.³

It is precisely because of this failure that Newton succeeded in replacing Descartes' Principles with his own Principia. Certainly Newton learned from Descartes, as well as Galileo, the value of mathematics in science, but he also learned from Francis Bacon and Robert Boyle the value of observation. The

senses may not be perfect, but they are necessary to natural science. Furthermore, Newton begins with mathematical, not metaphysical principles, although the use of mathematics in science involves certain metaphysical presuppositions.

Descartes' rationalism also had philosophical consequences, from which philosophy has not yet escaped. He maintained Aristotle's concept of space, but appeared to reject Scholasticism, although he retained the traditional order of knowledge. He seems, however, to turn to Plato in his mathematical approach to nature. Shapere has discussed one important point where Descartes differs from Plato in this respect:

Thus, for Plato, Nature— the world in which we live, the world of change, of Becoming— contains an essentially irrational element: nothing in it can be described exactly by reason, and in particular by mathematical concepts and laws; and any deviations from those concepts or laws are inherently unexplainable. True, mathematics enables us to deal fairly well with this world; but still it gives only a 'likely story.'

While it may be true generally that as modern science developed man became less concerned with substance (Being) and more concerned with variability or contingency (Becoming), what has happened in Descartes' Principles is that the Universe has become a totally rational machine. The element of contingency has all but been removed. For Descartes it is being misrepresentative of the nature of God to suggest that any more change than is necessary really occurs in the universe. This is why time has almost no function at all in Descartes' philosophy. His world is as cold and rigid as his identity of space and body as extension. The world appears to be changing and exciting, but once its essence is grasped, we discover it is eternally the same. God does not allow even the amount of motion in the universe to vary. Descartes has almost attempted to transform variability into substantiality, to transform the world of

Becoming into the world of Being.\textsuperscript{1} Determinism is inevitable. It may be that the Copernican revolution caused Descartes, and perhaps Newton, to be preoccupied with the idea of space. Whatever the cause, the machine analogy of nature generally ignores the concept of time.

This lack of concern for time in his work causes Descartes to be essentially anti-historical, a point at which we shall find contrast with Newton. Gibson notes,

The two principal preoccupations of Descartes were his mathematical method and his personal approach to philosophy. In both there lurks a hostility to the historical outlook. The necessary truths of mathematics are independent of temporal changes. They are always necessary. The order in which they happen is irrelevant to them; their articulation is not that of events of time. On the other hand, the personal approach... imposes simply the duty of reflecting methodically on the implications of his own experience.\textsuperscript{2}

This might suggest that Descartes' rationalism could hardly be behind what J.B. Bury describes as The Idea of Progress, which is essentially a historical world view, but Bury maintains that Descartes' "genius exercised a more extensive and transforming influence on the future development of thought than any other man of his century."\textsuperscript{3} This is because Descartes' philosophy had confidence in man’s reason as a power to promote progress. Belaval, in his work Leibniz critique de Descartes,\textsuperscript{4} has shown that perhaps more than anyone else Leibniz

\textsuperscript{1} Mascal has well pointed to the conflict here; "However much it must recognise in principle the contingency of the universe, what science is looking for is its rationality" (Mascal, Christian Theology, p. 96). Thus Descartes and Newton really represent a difference in degree rather than in kind, as we shall see, but the differences are fundamental.

\textsuperscript{2}Gibson, Descartes, pp. 3-4.


\textsuperscript{4}Yvon Belaval, Leibniz critique de Descartes, from the "Bibliothèque des Idées." (Paris: NRF, Librairie Gallimard, 1960); Belaval observes in reference to Descartes, "Sa Physique est intemporelle: le temps n’y intervient" (p. 110).
should receive credit for reconciling rationalism and history. Both Descartes and Leibniz share a common concern for a rational mathematical universe, but whereas Descartes acts with reproach towards history, Leibniz in fact embraces it with joy. How does this reversal take place? Leibniz finds the radical Cartesian dualism between unextended mind and extended body unsatisfactory, and instead he developed a theory of intelligible "monads" or substances which were the basic "stuff" of the universe, so that the universe had a built in principle of "universal harmony" which resulted in the Platonic "best of all possible worlds." And says Belaval, the idea of optimistic progress naturally follows:

Unité, continuité: mais Dieu n’eut pas choisi le meilleur, si le monde se développait sans progrès. Ce progrès a deux sources: la perfection impliquée dans la notion complète du meilleur des mondes possibles et qui doit s’actualiser dans le temps; l’inquiétude, essentielle à la conscience qui pousse à la recherche du plaisir, signe de perfection. La perfection total de l’univers est-elle constante? Oui, sans doute, si nous tirons cette constance de la notion complète.

Perhaps Leibniz was interested in the problem of history because "Leibniz s’est occupé d’histoire et d’affaires publiques," whereas Descartes was shy and withdrawn, although as we shall see, Newton was even more shy, but he nevertheless had an interest in history and politics.

The philosophy of Descartes tended to have serious consequences for Christian theology in general, and for eschatology in particular. First of all, he seems to have followed the philosophical tradition of arguing for the

1Ibid., pp. 88-96. 2Ibid., pp. 99-104
3Leibniz says, "Where there are no parts, there can be neither extension, nor shape nor divisibility. Monads are the real atoms of Nature" Herbert W. Carr, The Monadology of Leibniz (London: Faber Press, 1930) p. 32.
4Belaval, Leibniz, p. 114. 5Ibid., p. 110
immortality of the soul, and with his emphasis on mind he would hardly stress the idea of the resurrection of the body. The soul, rather than the body, seems to be immortal because "a body is by nature always divisible, and the mind is entirely indivisible." The mind seems to have the property of the geometric point which we saw in Plato and Aquinas. Furthermore, this is carried on even more strongly in the idea of the "monads" of Leibniz. A monad is very much like a moving geometric point which was the subject of the calculus of Leibniz. Leibniz once discussed the "mind" in relation to geometry in an early letter which anticipates his "monads:"

Gleichwie in Centre alle strahlen concurriren, so lauffen auch in mente alle impressiones sensibillum per nervos zusammen, und also ist nens eine kleine in einem Punct begriffene Welt, so aus denen ideas, wie centrum ex angulis besteht, dann angulus ist pars centri, obgleich centrum indivisibel, dadurch die ganze natura mentis geometric explaining issued werden kann.

The monads, once created by God, are eternal thinking substances which can join together to make various visible objects; so in the "rational" tradition there is again a link between the "soul" and the geometric point, almost the geometric centre-point of a sphere, each monad providing its own universe. J.W. Nason in his article "Leibniz's Attack on the Cartesian Doctrine of Extension," causes us to wonder if God, for Leibniz, is not something like a Chief Monad. This tradition of the rational soul-star-sphere-geometric-centre-point which we saw originate in Plato, and saw maintained in the Angels of Aquinas,

and which we find also in the metaphysics of Leibniz, even finds current expression in Christian piety. There is a hymn by Oliver Wendell Holmes which reads:

Lord of all being, throned afar,
Thy glory flames from sun and star;
Centre and soul of every sphere,
Yet to each loving heart how near! 1

Perhaps the chief difficulty caused by Descartes' concept of space, as far as the Roman Catholic Church was concerned, was his identification of the essence of body with extension. Nason has pointed out that this created great difficulties for the Catholic doctrine of Transubstantiation.

If the essence of material stuff is its extension, and if the volume or extension of the host remains the same, how can it be said that the bread and wine have been converted into the body and blood of Christ? More difficult yet is the question, how can the body and blood of Christ be in many different places at the same time?

Descartes answered that Transubstantiation takes place when the soul of Christ infuses the elements, a plausible explanation, but more Augustinian than Thomistic, and as Nason points out, Protestants had often used Augustine to oppose Aquinas. 3

Descartes, in his personal approach to philosophy, in fact had much in common with Augustine. 4 This has been another source of theological criticism of the Cartesian method. Karl Barth has taken a strong stand against Descartes because he advocates a subjective anthropomorphism in theology. In his Dogmatics Barth discusses Descartes' Meditations, and he observes:


3Ibid., pp. 454-55.

4Cf. M. W. Kehr, "Doctrine of the Self in St. Augustine and in Descartes," Philosophical Review, Vol. 25, pp. 587-615. The philosophy of Augustine and Descartes are both "personal," and both are concerned with "The certainty that I exist" (p. 587), which is "the basis of their philosophical systems" (p. 615).
If in the fifth meditation the idea of God is produced out of the twofold of the human mind, in the third it is deduced from its deficiency... The God of Descartes is hopelessly enchained within the mind of man.

The eschatological consequences of Descartes' anthropocentric rationalism have been discussed by James Martin in his work *The Last Judgment*, and by E.L. Tuveson in *Millennium and Utopia*. Martin and Tuveson, like Bury,

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1. J. P. Bury, *Die kirchliche Dichtung* (ed.) G. Bromley and T.P. Tuccurce (Vol. I-IV, Edinburgh, T. & T. Clark, 1956-70), Vol. III, Part I, pp. 370. Barth approaches his whole theological task with an eye on "the modern view against which we have to fix our limits" and this subjective rationalism "goes back to the enlightenment and particularly to the Renaissance philosopher Descartes with his proof of God from man's certainty of himself" (Vol. I, Part I, pp. 222-773). Robert E. Cushman has drawn attention to the fact that the theology of Barth is essentially a theology built against the Cartesian form of rationalism. In his article, "Barth's Attack Upon Cartesianism and the Future in Theology," Journal of Religion, Vol. 36, pp. 17-27, he says that Barth's epistemology admits that man knows, but "knowledge is something that happens to him in the determination of his existence" (ibid., p. 217). Barth stands within the rationalist tradition which moves from Augustine to Descartes, Schleiermacher and Tillich, and Cushman suggests "there is really no historical notice" for the sort of epistemological theory which he [Barth] has adumbrated unless we are to find a counterpart in Francis Bacon's direct physical realism and pervasive insistence upon the humble submission of the individual to the impressions of nature as the condition of knowledge." (ibid., p. 217). Cushman suggests that Tillich, unlike Barth, hopes to "create a Locis, by means of rational anthropology, the Christian Weltanschauung along with its kerygmatic and eschatology." (ibid., p. 200). McRae essentially contrasts Descartes and Bacon in such a way as to suggest a parallel between the epistemology of Barth and Bacon. McRae notes that for Bacon "the conquest of nature is dictated by religion, for all questions of moral end..." (ibid., p. 35). For Descartes, however, "moral decisions are determined wholly in the natural light of reason." (ibid., p. 35). Bacon attempts to derive his morality from Scripture.

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find that rationalism provided an interpretation of the universe which tended to ignore the biblical world view, or at least to interpret the biblical world view in its own categories.

The concept of the "uniformity of nature" according to Martin "ruled out any Heilgeschichte as a medium of revelation."¹ In fact, the universe of Leibniz could hardly be called corrupt, nor in need either of judgment or salvation.² As a rational being man became master of his own destiny in a rational universe, and eschatology as a concern for the future became "the idea of a potentiality of the future coupled with optimism."³ The "machine" model had its consequences.

The mechanical view excluded the consideration of ends or of finality because now quantitative relations in time and space replaced the traditional view of qualitative powers behind essences and changes ... ⁴ Reality was no longer primarily a question of personal will and purpose.

Furthermore, both German and English thought tended to use reason to establish and defend religion, which admitted the priority of the rational before it began.⁵ Martin finds both Pietism and Puritanism influenced by rationalism.⁶


²Ibid., p. 103.

³Ibid., p. 123.

⁴Ibid., p. 89.

⁵Ibid., pp. 28-35. Dietrich Korn, Das Thema des Jüngsten Tages: in der Deutschen Literatur des 17. Jahrhundert (Tübingen: Max Niemeyer, 1957) mentions the tendencies of "chiliastischer" which also supports Tuveson's Millennium theory, but he also says, "Die pietistischen eschatologischen Kampflieder lassen oft nicht erkennen, ob die Weisungen des zukünftigen Gerichtes auf den Jüngsten Tag oder auf den Anbruch der Herrschaft der Gläubigen hinweisen" (Cf. the Forward). Korn found the writings of Paul Felgenhauer concerning the "Parusie Christi zum Jüngsten Tage" very dominant, although this material is not treated by Martin, who has not concerned himself with German prose and poetry.
Tuveson has traced out the path from the Reformation which found its interpretation of history rooted in biblical apocalyptic literature, especially Daniel and Revelation, and which later moved away from a polemic use of the idea of the millennium to an optimistic interpretation of man's working out the millennium himself, with the aid of science and reason.\(^1\)

Still unanswered is the question of how the Ascension of Christ can be interpreted in terms of the Copernican world view. Aquinas had spoken of Christ ascending beyond the outer Ptolemaic sphere. Descartes had decided that the extension of space was "indefinite." How could Christ ascend beyond an "indefinite" extension?

There are some of the eschatological difficulties which are raised by the work of Descartes, although he is not the only one responsible for them, but he is certainly a key figure. We have asked in the previous chapter, 1) what is permanent in existence, and 2) what is the purpose [God's purpose] for existence? 1) Descartes found that God was especially permanent, but that he had created our indivisible minds so that they too are basically permanent and uncorruptible. Mathematical or logical reason is also permanent. We can trust it, especially since it guarantees us that God would not deceive us! When Descartes works out his physics, we suspect that a universe which is an almost perfect machine, maintained at a constant velocity, may also be permanent. There really seems to be little need either for salvation or for Christ and his eschatological acts—crucifixion and resurrection. 2) Furthermore, Descartes believes that we discover purpose for existence in reason, or else it is something which belongs to the mind of God alone; "we ought to beware lest we

presume too much in supposing ourselves to understand the ends which God set before Himself in creating the world."\(^1\) Certainly Descartes would accept all the articles of the Christian faith because he submits all his beliefs to the authority of the Catholic Church, which has possession of knowledge revealed by faith. What Descartes does not make clear is why it is "reasonable" to accept revealed truth which may appear contradictory to reason. May not the church deceive us? May we not doubt the church? These questions, in light of the Reformation, were bound to be read into Descartes' philosophy, although he did not do so himself. We shall see that the work of Isaac Newton is a mixture of acceptance and rejection of the philosophical, scientific and theological method and conclusions of Descartes' *Principles of Philosophy*.

\(^1\) *Prin.* (H) III, 2, p. 270.
CHAPTER III

THE INFLUENCE OF NEWTON'S THEOLOGY ON HIS SCIENCE

A) Introduction: Isaac Newton — Mystic, Rationalist or Empiricist?

In the work of Sir Isaac Newton (1642-1727) we shall find a considerable contrast in the way in which the concepts of time and space are conceived in comparison with what we have seen in Plato, Aristotle and Descartes. One would indeed have been tempted to say that Chapters I and II of this paper have nothing to do with Chapters III and IV, if it had not been for the fact that in 1962 A. Rupert Hall and Marie Boas Hall published a previously unpublished article by Newton entitled, "De Gravitatione et Aequipondio Fluidorum,"¹ a title which gives no indication of the nature of the article's subject matter. In this paper Newton devotes only a few sentences to the problem of gravity in fluids before realizing that he must first come to grips with the Cartesian concept of space. Consequently his whole attention is devoted to the problems of the nature of space, place and body — this article is the link between Descartes' Principles of Philosophy and Newton's Principia, for in it we find Newton attempting to reject Descartes, and attempting to find an alternative. Here we find Newton himself at an "interim" state. The article was written perhaps fifteen years before the publication of the Principia, and in it we find Newton much more willing to deal with metaphysical questions than he was later in life. At this stage Newton had not completely rejected metaphysics, although he had clearly rejected Descartes. By the time Newton published the Principia.

and by the time he prepared most of his theological manuscripts, he had made a conscious attempt to reject metaphysics in both his science and his theology.

In "De Gravitatione" we find in embryonic form the ideas of space and time which will eventually serve as the foundation of the Principia. Here we also find Newton's statement of the relation between God, Space and Time, so that we know his later statements in the General Scholium to the Principia were ideas which Newton had long held. In this article we also see the beginning of the role of time and space in Newton's scientific method, which later formed part of the introductory material to the Principia. Thus "De Gravitatione" provides the vital link between Descartes' Principles and Newton's later Principia. And we shall see that the concept of space is of more importance to Newton than is the concept of time, although time later becomes important in his theology, and time is important in science too in regard to the process of verification.

In Chapter III we shall be investigating the "Influence of Newton's Theology on His Science," and by this we mean to explore the relation between space and God suggested by Newton. We shall examine the context in which the scientific thought of Newton developed, paying special attention to Henry More, Isaac Barrow, and Robert Boyle. Then we shall examine what we have called "ontological" aspects of Newton's concept of space as they appear in "De Gravitatione" and also in the General Scholium to the Principia, and then we shall turn to what we call "epistemological" implications of Newton's concepts of space and time, especially as they have been set forth in the Scholium to the Principia. We shall be interested in Newton's conclusions about reality, and about the way reality should be known.

We shall also in this chapter briefly consider aspects of Newton's letter to Thomas Burnet concerning the Mosaic Creation, and also his letters
to Richard Bentley concerning the evidence which his science offers for the existence of God.

Chapter IV examines "The Influence of Newton's Science on His Theology," and we shall begin by studying Newton's doctrine of the church because it is necessary to have this perspective in view when reading Newton's theology in order to avoid some of the mistakes that have been made in the past in evaluating Newton's theology. We shall relate Newton to men such as Lord Falkland and Joseph Mede, and we shall classify Newton as an "Anglo-Puritan". Then we shall turn to an evaluation of the method involved in the majority of Newton's theology, his "historico-prophetic" theology. We shall see here a strong parallel between his method of what may be called "eschatological verification" in science and theology. Finally we shall explore the way in which Newton's concepts of space and time as developed in his science work themselves out in his eschatology. Here, for instance, we shall see Newton relating his concepts of Space, God, and the Temple of Solomon. We shall also see that Newton develops a literal but invisible concept of the Millennium, and that Newton's concept of history, and his concept of prophetic fulfilment are quite "mechanical" or geometrical -- history and theology in Newton seem to reflect a determinism parallel to that which we find in the mathematical work in his science.

Out of this whole context we shall also be attempting to come to grips with the nature of Newton's theology in general. We cannot escape the great debate which has raged as scholars have attempted to come to grips with the religious personality of Newton. Up to the present time the debate has moved between two poles. 1) Newton has been interpreted as a religious "mystic," or 2) he has been seen as a religious "rationalist." There is some truth in
both of these claims, but we have found that neither of these formulas separately, nor both of them together, really captures the focal point of what it is that Newton is doing in his theology. Therefore we have sought to find a tertium quid between the "mystic" and "rationalist" schools of thought. Newton approached his theology with much the same mentality as he approached his science. He was concerned with experimental verification in his science, and it is this which separates him from Descartes, and we have also found in Newton's theology something which might be called experimental verification. It does not seem proper to call Newton a religious "scientist" or a religious "experimentalist," and so we have chosen instead another term. We have decided to call Newton a religious "empiricist." We are not, let us say immediately, using the term empiricist in a strict philosophical sense as it has come to be used in the twentieth century. Newton was not a philosopher. He was a scientist. But if British empiricism began with Francis Bacon or John Locke, it did so in reaction against Descartes' rationalism, and it attempted to model itself on the scientific method of Newton. Perhaps we would have done better to find a more "neutral" term than empiricist, but it is a term which might be applied equally well to science and theology, and we need a term which will point to a unity of method in these two disciplines in Newton. To call Newton either a religious "mystic" or a religious "rationalist" seems to suggest that the mentality with which Newton approached his science was quite different from the one with which he approached his theology, and we have not found this to be the case. Let us examine the three alternatives in detail: Was Newton a religious 1) mystic, 2) rationalist, or

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1Urmson, Western Philosophy, pp. 122-124.
Was Newton a Religious "Mystic"?

In 1957 Richard S. Westfall published an article entitled, "Isaac Newton: Religious Rationalist or Mystic?" In this article we see reflected the two poles of debate up to the present time, in this case the author is arguing against the "mystic" theory, thereby hoping to demonstrate the "rationalist" formula. What we are asking is, Is there not perhaps a third alternative to these two extremes?

Newton's theology has not been open to the most favorable examination. In his biography of Newton the Frenchman M. Biot "reconciled" Newton's science with his theology by suggesting that since Newton suffered something like a nervous breakdown — or a period of insanity — during the year 1693, that Newton wrote all his science before that date and all his theology after it. Brewster and L.T. More have refuted this thesis by showing that Newton was corresponding with Henry More concerning biblical prophecy as early as 1680, but since both Brewster and L.T. More in their biographies of Newton discuss Newton's theology last — just before Newton dies — one is left with the impression that perhaps Biot's theory that Newton's theology was slightly

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1 Richard S. Westfall, "Isaac Newton: Religious Rationalist or Mystic?", Review of Religion, Vol. 22, pp. 155-170. Westfall has also written the book Science and Religion in Seventeenth-Century England (New Haven: Yale University Press, 1958); in this book Westfall traces the development of "rational, natural religion" through the seventeenth century, and he devotes his eighth and final chapter to "Isaac Newton: A Summation" (pp. 193-220). Westfall begins his discussion of Newton's theology by referring to Newton's letters to Richard Bentley. In our opinion Westfall would have been much wiser to begin with Newton's theological writings if he had really wanted to uncover the character of Newton's theology; but it may be that Westfall had decided before he wrote his book that Newton would be a "Summation", that he would easily lead to eighteenth century rationalism.
Newton held an Arian Christology, and consequently Bishop Horsley hesitated to publish much of Newton's theology in his *Opera*, and Brewster tried to cover up Newton's Arianism, so that L.T. More had to set the record straight, and Unitarians such as H. McLachlan have tended to take Newton's Arianism as a starting point and have ended by making Newton into a "free-thinking" leader of rational Unitarianism. This, together with the fact that Newton's theology is still to quite an extent unpublished, has resulted in the fact that Newton's religious personality has been subjected to a variety of stresses and strains. And the lack of the publication of Newton's theology has resulted in the attempt by scholars, especially by historians of science, to reconstruct Newton's theology from the few religious comments Newton makes in his scientific works. We can easily see what type of distortions might result from this method if we just imagine the process in

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reverse — imagine someone trying to deduce Newton's scientific opinions by studying Newton's theological writings, such as his Observations on the Prophecies of Daniel. ¹

One historic example of the distortion of Newton's religious and scientific position was provided by William Law in 1740 who suggested that Newton had simply transformed the mysticism of Jacob Boehme into the principle of gravitation found in the Principia. It should not surprise us to learn that Law was a mystic and an admirer of Boehme. In 1937 Stephen Hobhouse published an article entitled "Isaac Newton and Jacob Boehme,"² in which he demonstrates that perhaps a dozen authors including Marjorie Nicolson, E.A. Burtt, C.F.E. Spurgeon, D. Brewster, A.J. Snow and L.T. More have subscribed "uncritically" to the thesis concerning the relation between Boehme and Newton, and Hobhouse finds Law as the only source. He then demonstrates that Law had only hearsay evidence, and that very poor; there is no evidence of Boehme's works in Newton's library.³

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³ Ibid., p. 25, n. 1. Hobhouse claims that all claims to make Newton into a mystic after the order of Boehme go back to "certain statements made by William Law (1686-1761)" (p. 25). Law tried to compare Newton's three laws of motion with Boehme's three "Properties of Eternal Nature," (p. 28), and also Law suggested "When Sir Isaac Newton died, there were found among his papers large abstracts out of J. Behmen's works written in his own hand" (p. 28); But Hobhouse goes on to show that Law simply "heard" about this from Humphrey Newton, Sir Isaac's secretary -- and there seems to be no evidence for the allegation in Newton's manuscripts. Furthermore, Hobhouse goes on to show that there is almost no relation between Boehme's and Newton's three laws. (Hobhouse does not mention Descartes' three laws of Nature, which Newton had read.) Hobhouse does seem to undermine successfully the claim that Newton was related to Boehme on the evidence put forth by Law, and we agree that he thus undermines this aspect of the work by Karl Robert Popp, Jakob Böhme und Isaac Newton (Leipzig: Verlag Von S. Hirzel, 1935), (Cf. Hobhouse, pp. 52-54). For a catalogue of the contents of Newton's personal library, cf. Richard De Villamil, Newton: The Man (London: Gordon D. Knox, [1931]).
The fact that the relation between Newton and Boehme has been undermined by Hobhouse -- and we basically accept his thesis -- might suggest that thereby the "mystic" theory has been undermined, and this is essentially the conclusion drawn by Westfall. But Newton could have developed his own mysticism -- he need not have had any teachers. Furthermore, there is one weak point in the argument of Hobhouse. He argues that Newton did not derive his idea of gravitation from Boehme, and we agree. But Karl R. Popp in his work Jakob Böhme und Isaac Newton not only pointed to the thesis of William Law in support of his claim, but he also suggested that Newton was indirectly influenced by Boehme through Henry More. Hobhouse admits this is a possibility, though a weak one. While we do not agree with Popp that Henry More provides "Der Weg zu Newton," nevertheless there is something "mystical" in the way which More and Newton discuss the relation between God and Space, as we shall later see. But the mystical element is slight, and ought not to be used to comprehend the whole of Newton's theology. We believe Westfall is wrong to suggest that there is no sign of mysticism at all in Newton, but certainly mysticism is not the focal point of his scientific or theological work.

Part of the difficulty with the "mystic" thesis is that the term is so difficult to define. If mysticism is something like "immediate awareness of relation with God, direct and intimate consciousness of Divine Presence,"

1 Popp, Jakob Böhme, pp. 39-43.
2 Hobhouse, "Isaac Newton," p. 50.
3 Popp, Jakob Böhme, pp. 43-45.
then this is certainly not true of Newton. Of course all Christians, including Newton, who practise prayer can be said in this sense to be mystics, but this is not the best way to distinguish Newton. We must also realize that empiricism has been defined as the proposition that "the sole source of knowledge is experience," and if a mystic has "immediate awareness of relation with God," then we might suppose that mysticism is a chief form of religious empiricism. But mysticism has also been loosely used to mean "not capable of verification," whereas scientific empiricism has always been concerned with experimental verification. Thus if Newton is a mystic, he is not so in the usual sense, but rather he might be said to hold certain "occult" doctrines. Furthermore, to relate Newton's mysticism to that of Henry More presents difficulties since Henry More was a leader of the Cambridge Platonists — he was a religious rationalist. Separating mysticism, rationalism and empiricism will not be easy.

The thesis that Newton was a mystic took a slightly different form after 1940 in the work of E.N. Da C. Andrade and Lord John Maynard Keynes, both of whom prepared lectures which were delivered as part of the Newton Tercentenary Celebrations. Andrade perpetuated the error that Newton "was a close student of the mystic Jacob Boehme, from whose works he copied large extracts," despite the fact that he had not seen these extracts, and they have never been found.

1Ibid., "empiricism," Morris T. Keeton, p. 89.
2Ibid., "mysticism," Rufus W. Jones, p. 203.
Andrade believed that in his historical works and alchemy there were also signs of mysticism. "That it is exclusively mystical I do not believe — that there is a mystical element seems certain."¹

Perhaps even more important than Andrade's work is that by Lord Keynes. Keynes had collected or seen most of Newton's unpublished work, and therefore his opinion held even more weight than that of Andrade. In reference to Newton's unpublished work, Keynes said, to refute the view that Newton was a "rationalist,"

Let me give some brief indications of their subject. They are enormously voluminous — I should say that upwards of 1,000,000 words in his handwriting still survive. They have, beyond doubt, no substantial value whatever except as a fascinating sidelight on the mind of our greatest genius.

Let me not exaggerate through reaction against the other Newton myth which has been so sedulously created for the last two hundred years. There was extreme method in his madness. All his unpublished works on esoteric and theological matters are marked by careful learning, accurate method and extreme sobriety of statement. They are just as sane as the Principia, if their whole matter and purpose were not magical.²

In his comment that in these unpublished works of Newton "There was extreme method in his madness" we have echoes of Biot's reconciliation of Newton's science and theology; these other works appear slightly "insane." Not only does Keynes say that Newton's unpublished works were "magical," but that Newton himself was a "magician." Newton's "deepest instincts were occult, esoteric, semantic."³ Keynes is not so much calling Newton a "mystic" as a "magician."

¹Ibid.
³Ibid., p. 28.
Why do I call him a magician? Because he looked on the whole universe and all that is in it as a riddle, as a secret which could be read by applying pure thought to certain evidence, certain mystic clues which God had laid about the world to allow a sort of philosopher's treasure hunt to the esoteric brotherhood. He believed that these clues were to be found partly in the evidence of the heavens and in the constitution of elements (and that is what gives the false suggestion of his being an experimental natural philosopher), but also partly in certain papers and traditions handed down by the brethren in an unbroken chain back to the original cryptic revelation in Babylonia. He regarded the universe as a cryptogram set by the Almighty — just as he himself wrapt the discovery of the calculus in a cryptogram when he communicated with Leibnitz. By pure thought, by concentration of mind, the riddle, he believed, would be revealed to the initiate.¹

By this single "magician" formula Keynes hopes to explain the variety of Newton's interests, not only his science, but also his "alchemy" which Keynes considers part of Newton's magic.² But this formula also explains Newton's theological and historical works.

Another large section is concerned with all branches of apocalyptic writings from which he sought to deduce the secret truths of the Universe — the measurements of Solomon's Temple, the Book of David, the Book of Revelations, an enormous volume of work of which some part was published in his later days. Along with this are hundreds of pages of Church History and the like, designed to discover the truth of tradition.³

In addition to assigning Newton's religion to the sphere of "magic," Keynes also went on to explain the anti-Trinitarian aspect of Newton's theology by saying that Newton was not so much a "Socinian" as "a Judaic monotheist of the school of Maimonides."⁴ How Newton's magic fits in with Maimonides we are not told. What must be kept in mind, however, is that Keynes had seen all of Newton's unpublished manuscripts before they were sold.

¹Ibid., p. 29. ²Ibid., p. 31. ³Ibid. ⁴Ibid., p. 30.
Did Keynes ever have any support, in an external sense, for his conclusions? The Sotheby Catalogue of the Newton papers sold in 1936 had been carefully compiled by John Taylor, a member of Messrs Sotheby staff. The catalogue is an excellent piece of work, and we must believe that Taylor saw every manuscript mentioned in the catalogue. What do we read in the Foreward to the catalogue?

The Alchemy that Newton practised had more than its vocabulary in common with Mysticism, and no doubt it was by way of Alchemy that Newton entered upon the Interpretation of the Prophecies which forms so large a part of his Theological writings.

There may even be some relation to his unorthodox Trinitarian position and his mysticism.

There is thus a strange parallel between his Alchemical and Religious opinions, both so difficult to reconcile with his official position.

How do we account for Newton’s interest in chronology?

Closely connected with the Theological MSS. are those on Chronology, amounting to nearly a quarter of a million words. They include some extremely interesting papers on Calendar Reform, and a series relating to the posthumous publication of the "Chronology" which occasioned the wonderful letter from Pope included in the lot (224A).

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1 A.L. Munby in his article, "The Keynes Collection of the Works of Sir Isaac Newton at King’s College, Cambridge", Notes and Records of the Royal Society of London, Vol. 10, pp. 40-50, had discussed the collection of manuscripts which Lord Keynes purchased in 1936 and later gave to King’s College. It was from this collection that McLachlan published Newton’s Theological Manuscripts. Newton’s manuscripts were sold in 1936 by Messrs Sotheby and Co., and Munby names in his article on the Keynes collection Mr. John Taylor as the compiler of the Sotheby Catalogue. Taylor seems to have written the introduction to the Catalogue, although the pages are unnumbered, and it is to this introduction that we now refer.

2 Taylor, Sotheby Catalogue, in the Foreward, no page.

3 Ibid.

4 Ibid.
Thus the claims of Keynes seem to have independent support. If these claims by Keynes are to be undermined, it will have to be by some other interpretation of Newton’s work itself. Andrade made the following comment as to the significance of the Keynes analysis of Newton:

Whether the reader is prepared to follow Lord Keynes all the way or no, surely it is sufficiently remarkable, sufficiently indicative that there was something very strange about Newton, that opinions of this kind can be upheld by a balanced and deeply learned scholar, who was also a man of the world.¹

This is indeed something which should be pondered, although it is important to keep in mind the question, Would Newton’s material look so "strange" to someone in the seventeenth century? The important point about the Keynes analysis is that he makes no mention of Jacob Boehme. His argument is not so much that Newton was a "mystic" as an "occult magician." Westfall does not take notice of this change, and it is an important change from the previous "mystic" view of Newton. Whether or not Newton’s whole personality was "mystical" or "magical" is at stake. If this account is true, how did he ever gain the reputation which he now has as one of the greatest scientists ever to have lived? The answer is that although he was a good scientist, his alchemical, historical and "prophetic" studies reveal his "magical" interests. In public he appeared to be a scientist, but in his inner personality he was a mystic-magician. We must not underestimate the impact of the Keynes analysis on Newtonian scholarship. We find that a scholar such as Lynn Thorndike in the final volume of his History of Magic and Experimental Science (1958) almost uncritically accepts the Keynes analysis of Newton.²


2) Was Newton a religious "rationalist"?

The alternative to seeing Newton as a religious "mystic," by which is meant that Newton's interests were magical and occult, is to believe that Newton was a religious "rationalist," as argued by Westfall in his article, "Isaac Newton: Religious Rationalist or Mystic?"

The view that Newton was a religious rationalist also has a long tradition. It was to replace this tradition that Keynes wrote his "mystic-magician" account of Newton. Keynes said,

In the eighteenth century and since, Newton came to be thought of as the first and greatest of the modern age of scientists, a rationalist, one who taught us to think on the lines of cold and untinctured reason .... Newton was not the first of the age of reason. He was the last of the magicians.¹

After Newton's scientific reputation was developed, his "magical" works were stored away from sight and

Magie was quite forgotten. He became the Sage and Monarch of the Age of Reason. The Sir Isaac Newton of orthodox tradition — the eighteenth-century Sir Isaac, so remote from the child magician born in the first half of the seventeenth century — was being built up.²

Keynes is arguing that to see Newton as a "rationalist" is a "mythical" interpretation fostered on Newton by his successors. To a certain extent this is true, but there are difficulties.

If we found it difficult to define the term "mystic" in its application to Newton, the same must be said of the term "rationalist." When Keynes uses the term "rationalist," he means that "A case can be made out, as it also can with Descartes, for regarding him as an accomplished experimentalist."³ This

¹Keynes, "Newton," p. 27.
²Ibid., p. 33.
³Ibid., p. 28.
presents obvious difficulties. 

In our previous chapter we saw that Descartes has, according to most philosophical definitions, been classified as the first "rationalist," but the major divide between Newton and Descartes is that Newton rejected Descartes' a priori rationalism in favor of an experimental method. To see Descartes and Newton as experimentalists, as Keynes suggests, thus causes further confusion, which will only be removed in the course of our study.

If Newton were a religious "rationalist" after the order of Descartes, we would expect Newton to base his religious beliefs on a priori principles such as those of Descartes. This creates difficulties because we cannot help wondering why Newton would be willing to base his religion, although not his science, on a priori principles.

Another way of seeing Newton as a religious rationalist is to follow the course taken by E.A. Burtt, among others, who in his Metaphysical Foundations of Modern Physical Science suggested that Newton imported certain religious metaphysical principles, especially concerning space and time, from his religion into his science. This would suggest that Newton was a religious metaphysician, and we will examine this position below in detail.

Keynes, however, is fighting against the view that Newton belongs to the Age of Reason, to the eighteenth century. The difficulty here is that in the eighteenth century the idea of "reason" and "rationalism" takes on a new meaning due to the influence of Newton himself. As Ernst Cassirer points out in his work The Philosophy of the Enlightenment.

---134---

1 Cf. Urmson, Western Philosophy, p. 339.

The attempt to solve the central problem of philosophic method involves recourse to Newton's "Rules of Philosophizing" rather than to Descartes' *Discourse on Method*, with the result that philosophy presently takes an entirely new direction.¹

While the philosophic method of Descartes, Malebranche, Leibniz and Spinosa was thus called into question by the eighteenth century, in fact the confidence in "reason" which these early rationalists exhibited was enforced in the mind of the Enlightenment by the work of Newton. But since Newton caused the rejection of Descartes, we might expect Newton's "rationalism" to take a different form.

Newton's scientific method, together with the influence of men such as Francis Bacon and Robert Boyle, brought forth a new philosophy which explained Newton's method. This was the purpose of the *Essays Concerning Human Understanding* (1690, three years after Newton's *Principia*), by John Locke, Newton's friend at Oxford. The difficulty with calling this type of philosophy "rationalism" is that Locke is usually classified as the first of the "empiricists," in order to distinguish him from Descartes.² Thus if any attempt to classify Newton as a religious rationalist is likely to succeed, we would expect it to take the form of comparing Newton with Locke rather than with Descartes.

This has been the program set forth by R.S. Westfall, and also by the Unitarians such as H. McLachlan in his account of Newton,³ and also by McLachlan's son H. John McLachlan in his work, *Socinianism In Seventeenth-Century England*. In this work we find reference to Locke's *Reasonableness*

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of Christianity (1695) in which, in H.J. McLachlan's view, Locke makes reason the lord over religion. "Reason is the arbiter of what is or is not revelation."\(^1\) Reason controls revelation, revelation does not control reason. This same line of argument is followed by Westfall, and it is difficult to refute entirely. Westfall argues that "Little separated Newton's religion from the 18th century's religion of reason — only the name 'Christianity' and an attitude which the name implied."\(^2\) Westfall, however, spends most of his time studying Newton's occasional religious comments in his scientific writings, and in his twenty seven page chapter on Newton's theology in his book Westfall devotes only seventeen lines to Newton's "prophetic" theology,\(^3\) while the Sotheby Catalogue indicates that perhaps seventy percent, or over a million words in Newton's theological work are devoted to what we call "historico-prophetic" theology.\(^4\) Since Westfall has all but ignored this major section of Newton's theology (and the Unitarians have little use for

\(^{1}\) H.J. McLachlan, Socinianism in Seventeenth-Century England, (London: Oxford University Press, 1951), p. 329; he also talks freely about "the rational Christianity of a John Locke and an Isaac Newton" (p. 144), and about "Locke and Newton, precursors of the eighteenth century and representatives of 'the Age of Reason';" (p. 331). McLachlan also seems to suggest that Newton did not believe that "Jesus is an object of worship" (p. 331), whereas Newton says, "we are to worship ... Jesus alone as the Lord" [Newton, McLachlan (ed.), "Twelve Articles," Art. 12, p. 57].


\(^{3}\) Ibid., pp. 215-216.

\(^{4}\) This is our estimate derived by adding together the number of words suggested for each theological manuscript in the Sotheby Catalogue (pp. 64, Lot. No. 227 - pp. 74, Lot. No. 270). All of the lots are not related to "historico-prophetic" studies, and as far as we can determine, those not so related are not included in our estimate.
it either), we should perhaps at least reserve our commitment to Westfall until we have examined Newton's theology.

The difficulty with the idea of rationalism or reason as Westfall uses it is that it is something like John Locke's "common sense." It is easy to examine Newton's work and say that "he seems to be using common sense here." It would be difficult to read the Sermon on the Mount and not come to the conclusion that it exhibits a lot of "common sense," and thereby one could conclude that Jesus was a "religious rationalist." In fact, that is what the eighteenth century did with the teachings of Christ.

We shall attempt to separate Newton from Locke's position, although this cannot be done entirely, but two preliminary comments are in order: a) Locke was more of the humanist, he was the philosopher, Newton the scientist, and b) there is no evidence that Locke had more than occasional interest in what was for Newton the core of theology, his "historico-prophetic" studies. We must remember that to some people such as Biot and Keynes Newton's theology looks slightly "insane" rather than like "common sense." Why should this be the case? Various aspects of the "Religious rationalist" argument will become clearer in the course of our study, but the question of Newton's relation to Descartes, the Cambridge Platonists and John Locke will be of importance.

3) Was Newton a religious "empiricist"?

It has been essentially due to two facts that we have come to suggest the empiricist formula. a) It seemed impossible to reconcile the "mystic" and "rationalist" formulas, neither was totally adequate, each had its merits. Therefore we sought a tertium quid. b) We came to the conclusion that the

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1 Urmson, Western Philosophy, p. 215; cf. Mt. 5-7.
"mentality" with which Newton approached his religion was on the same level as his science. If Nature is for Newton a book to be studied, so were the Bible and History books to be studied. God is an object to be known, according to Newton, not so much through direct experience as in mysticism, but rather through revealed or mediated experience through Scripture and history. But this is the way, for Newton, that God is known. He is not known through Descartes' a priori principles. Neither is he known through "common sense." We must come to know God in the way he has chosen to make himself known to us, that is, through revealed Scripture and through history.

In his physics Newton is remembered for his famous phrase "hypotheses non fingo;" metaphysical hypotheses have no place in experimental philosophy.\(^1\) Newton is the champion of the experimental method against Cartesian metaphysics, and it is for this reason that we have examined Descartes before turning to Newton, so that we will see more clearly the contrast between Descartes and Newton. The fact that Newton attempted to remove metaphysics from physics has been one of the main reasons he has been remembered as a scientist rather than as a philosopher, and it was his science which eventually inspired philosophical empiricism.

But if this is true of his science, what is the case with his theology? At one point Newton says "That religion and Philosophy are to be preserved distinct. We are not to introduce divine revelations into Philosophy nor philosophical opinions into religion."\(^2\) In fact Newton goes so far as to speak in his theology of "vain Philosophy."\(^3\) What we have found in Newton


\(^3\)Ibid., "Irenicum," p. 34.
is an anti-philosophical bias equally as strong in his religion as in his science. How can anyone who is anti-philosophical be called a "religious rationalist"? Needless to say, we do not find R.S. Westfall mentioning this aspect of Newton's theology. There is a strong parallel between Newton's attempt to separate both science and theology from philosophical metaphysics. The relation might be seen thus:¹

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\begin{align*}
\text{Natural Science} & : \quad \text{Philosophy} \\
\text{Religion} & : \quad \text{Philosophy}
\end{align*}
\]

We have also found that Newton approaches theology mainly through Scriptures. Religion is a field of its own, just as science is. Thus there is not in Newton any attempt to "rationalize" the relation between his science and his theology.² Each discipline stands in its own right, and each must be separated from metaphysics. One does not begin either in science or in theology with the a priori. One begins with given "data," whether it be "nature" in physics or "biblical revelation" in theology. We are calling

¹ Throughout the rest of this paper we will try to summarize some of our main observations in "formula" fashion, for the sake of clarity. In each formula the concept on the left will be separated from the concept on the right by a colon. The colon represents two ideas: 1) is separate or different from, and 2) stands in relation to. In thus relating Natural Science to Philosophy we are saying that for Newton Natural Science is separate or different from Philosophy, but that it also stands in relation to philosophy in a particular way. We shall also have two or more items so set up in a single formula. The items in the left column always share a common relation with each other, and this common relation can be seen by examining the difference between the ideas on the left and those on the right. Thus Natural Science and Religion are on the left, and they both share a common relation to the item on the right -- to Philosophy, which is basically a relation of separation.

² Hobhouse, "Isaac Newton," made the observation that Newton "kept his religion apart from his philosophy, such as we have described it, and appears to have made no attempt to reconcile the two" (p. 52). By "philosophy" Hobhouse means Newton's science. Science and religion each stands on its own ground for Newton.
Newton a "religious empiricist" not through any strict philosophical use of the word empiricist, but simply as the word which best illustrates the unity of his scientific and theological method.

Perhaps the chief link between Newton's scientific and theological method can be seen by an investigation of the nature of "verification." Certainly Newton shared with Descartes a deep desire to find some means of establishing "certainty." Descartes attempted to establish certainty logically, by an a priori argument which led to cogito, ergo sum. Newton instead turned to the experimental method as his means of verification; verification was for Newton something more external to the person involved in the process of verification than with Descartes. Newton tended to search in the "outside universe" for verification, whereas Descartes searched within himself. This is of course an over simplification of the problem, but this is a useful contrast.

In Newton's theology verification is a major issue. This brings out not only the relation between Newton's science and theology, but it also points to another problem in Newton -- his doctrine of the Church. In our fourth chapter we will begin with an investigation of Newton's doctrine of the church, because Newton's type of Protestantism -- his strong anti-Roman Catholicism -- determined to quite an extent the type of verification he sought in his theology. Because he was anti-Roman Catholic, it was quite natural for him to turn to apocalyptic studies in the manner of Joseph Mede as a means of undermining the Roman Church. But his apocalyptic studies were also an expression of his empirical method of verification. In his physics Newton worked back and forth between theory and experiment, between theory and observation. Newton's observations led him to some theory, and the theory tended to "predict" certain natural phenomenon. When these predictions were
fulfilled, Newton assumed that verification had taken place.

In apocalyptic studies Newton discovered a "predictive" element in the Bible. These predictions, according to Newton, were historical. Therefore we are not surprised to discover that perhaps seventy percent of Newton's theological effort is devoted to the problem of interpreting biblical prophecy in terms of historical fulfilment. As Newton says,

For the event of things, predicted many ages before, will then be a convincing argument that the world is governed by Providence.\(^1\)

Eschatology was important to Newton for verification, especially the idea of the Second Coming of Christ. He said, "The event will prove the Apocalypse,"\(^2\) and thus the Christian religion. Newton's historico-prophetic theology occupies the major portion of Newton's theology, and we believe that Newton's motive and method is best described as "empirical." The "mystic-magician" theory of the type put forward by Keynes assumes that Newton's motive for studying apocalyptic literature was occult. On the other hand, Westfall is forced to say that Newton's apocalyptic work is a type of "rationalism." We do not believe that either term fairly represents what Newton is doing in the majority of his theological work, and therefore we have used the term "empiricist" as a \textit{tertium quid}. We do not pretend to use the term empiricist in a strict sense, but it seems to us to be a better "disclosure model"\(^3\) by which we can see through Newton's science and his theology to a basic unity in his personality, and to a unity in what might


\(^2\)Ibid.

\(^3\)Ramsey, \textit{Models and Mystery}, pp. 1-21; cf. above, Chapter I, p. 9.
be described as his understanding of the "nature of verification."

The closest anyone has come to our "empiricist" thesis is Frank Manuel in his work *Isaac Newton: Historian*. Manuel does not, however, reject the "rational-metaphysician" account of Newton suggested by men such as E.A. Burtt, or the "mystic-magician" account of Lord Keynes, but rather is content to live with both, despite their conflict. He does come to the conclusion, however, that "My reading of the historical works sustains the image of a traditionalist Newton ... The habits of the Master of the Mint and the physicist are not absent in the Bible commentator and the chronologist." Newton was essentially a church historian, although of course he was more. But it is important to see how unlike Descartes Newton is -- in his study of history, and in his derivation of theological beliefs from the revealed religion of the Bible rather than from "vain philosophy." Religion and philosophy, like natural philosophy and philosophy, must be kept distinct.

These then are our preliminary conclusions about Newton. One may well ask, How did Newton ever gain a reputation as a "mystic-magician" or as a "rationalist-metaphysician"? Both views seem to have two common roots which have caused these two extremely divergent views. 1) There is the problem of Newton himself, who when confronting any person who is attempting to understand him, leaves the person standing in awe of the tremendous scope and diversity and depth of the learning of this man. 2) More than most, perhaps, Newton has suffered from being interpreted through his friends rather than through his own work.

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2Ibid., pp. 9-10.
Let us turn to the first problem, Newton -- the Man. It is interesting to observe similar statements from Andrade and Lord Keynes about Newton's perception of the universe around him. Andrade said,

I feel that Newton derived his knowledge by something more like a direct contact with the unknown sources that surround us, with the world of mystery, than has been vouchsafed to any other man of science. A mixture of mysticism and natural science is not unexampled.\(^1\)

Lord Keynes explains Newton's genius thus:

I fancy his pre-eminence is due to his muscles of intuition being the strongest and most enduring with which a man has ever been gifted. I believe that Newton could hold a problem in his mind for hours and days and weeks until it surrendered him its secret. Then being a supreme mathematical technician he could dress it up, how you will, for purposes of exposition.\(^2\)

Each of these men has tried to come to grips with the genius of Newton, and as a result, as each surveyed his tremendous mental capacity, his variety of interests, the result was that unconsciously Newton has been given a kind of "deification," he has been given direct intuition of the "unknown," he has been called something of a "mystic-magician."

Lord Keynes wrote his mystic-magician thesis against the traditional view that Newton was the father of the Age of Reason. The "rational" interpretation of Newton against which Keynes writes might be called the reverse of the mystic-magician theory. If the mystic theory tends to deify Newton, the rationalist theory tends to reduce Newton's genius to something like Locke's "common sense," and this is especially true of Westfall's account of Newton. Westfall says,

In science Newton made momentous new discoveries which have placed his name foremost among the world's scientists; in religion, although he labored over his manuscripts with painful care, he produced nothing exciting and little new. Where in natural science he was a beacon guiding the way, in religion he was only a mirror reflecting conclusions reached by others.\(^3\)

\(^1\)Andrade, "Newton," p. 20

\(^2\)Keynes, "Newton," p. 28.

One can almost hear Westfall offering prayers of thanks that Newton's theology is so "inferior." He gives thanks that Newton is fallible, that in fact anyone with "common sense" could have done in theology what Newton did.

Thus the mystic and rationalist aberration of Newton has been in part due to the tremendous problem of trying to come to grips with Newton -- the Man, the mystics elevating him, the rationalists reducing him to the level of the common man. Newton was not a slightly insane mystic-deity, but he was an uncommon man.

The other reason for the rather divergent accounts of the "insane-mystic-magician" and "rationalistic-metaphysician-man-of-common-sense" views of Newton is that more than most men, Newton has suffered from having the opinions of others forced upon him as his own. Since much of Newton's theology has gone unpublished, this has been especially true of accounts of his religious perspective.

In the case of the "mystic" theory, it is clear from the work of Hobhouse that William Law simply could not resist the temptation to equate the work of Newton and Jacob Boehme, despite the lack of evidence that this was the case.¹

In the case of the "rationalist" theory, the instances are numerous. We shall see that Newton's theory of space, as well as his apocalyptic studies, both have certain parallels with the work of Henry More, with whom Newton was acquainted. There lies the temptation to identify Newton with the Cambridge Platonists. But Newton hated philosophy, and had almost no interest in Plato.

¹Hobhouse laments that William Law, seeking to support Boehme, yielded to the "temptation to introduce Newton's illustrious name in support of his hero," [Stephen Hobhouse, Selected Mystical Writings of William Law: Edited With Notes and Twenty-Four Studies In the Mystical Theology of William Law and Jacob Boehme (London: C.W. Daniel Company Ltd., 1938), p. 347].
There is also the temptation to identify the opinions of Newton and John Locke, and this might seem to have valid grounds since Locke and Newton were friends, and Locke based his philosophy on Newton's science. But Locke, not Newton, was the philosopher. It was Locke who wrote the *Essay Concerning Human Understanding*. While Locke and Newton did correspond concerning the book of Daniel, Locke never performed anything like Newton's tremendous research into apocalyptic and historical problems. It was Locke, not Newton, who wrote the *Reasonableness of Christianity*. We find the Unitarians and Westfall particularly quick to identify the positions of Locke and Newton, and while they had much in common, their differences are extremely fundamental.

Another of Newton's friends was Samuel Clarke. Clarke wrote *The Scripture Doctrine of the Trinity* in which he stated a basically Arian Christology. Newton undoubtedly shared many of Clarke's opinions, but it was Clarke, not Newton, who wrote this work. Unitarians are especially quick to forget this fact.¹ And it was also Clarke who defended Newton's concepts of space and time in *The Leibniz-Clarke Correspondence*. Historians of science such as A. Koyré have been tempted to forget that it was Clarke, not Newton, who carried on this debate, which was essentially metaphysical.² Certainly Newton was interested in the debate, but the fact that Newton did not carry on the correspondence himself seems to say something very basic about Newton's interest in metaphysics. Newton did not hesitate to correspond concerning scientific matters!

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² Alexandre Koyré, *From the Closed World to the Infinite Universe* (Baltimore: Johns Hopkins Press, 1957), see especially pp. 235-272.
Thus there are at least two temptations which must be kept in mind in reviewing the current analyses of Newton. 1) The temptation either to over-estimate or under-estimate him as a person, and 2) the temptation to interpret Newton through his friends rather than through his own work. We are not going to argue that no one had any influence on Newton! But we do believe that we should attempt in so far as possible to interpret Newton through Newton.

Perhaps we can summarize our problem in this way. Westfall states the problem thus: "Isaac Newton: Religious Rationalist or Mystic?" If the problem were raised in relation to Newton's science, could it not be stated thus: "Isaac Newton: Scientific Empiricist, Rationalist or Mystic?"? And if one will allow that the "empiricist" formula must be considered in the case of Newton's science as a real possibility, why does not the same possibility exist in the case of Newton's religion?

We are not going to argue that the "empiricist" formula solves all the difficulties in evaluating Newton's religious and scientific thought. Perhaps "empiricist" is not the best word, but we are convinced that it is better than either "mystic" or "rationalist." Certainly we have found elements which do point to both a "mystic-magician" and a "rationalistic-metaphysician" interpretation of Newton, although these are the exception rather than the rule.

When we explore Newton's doctrine of the church we shall see signs of the strong Puritan influence on Newton's Protestantism. We believe that Newton took the "garden of Eden" story in the Bible quite seriously, and in fact he looked upon the ancients as having at one point possessed the "pure truth," but that later, especially through idolatry, men departed from it. Thus when Newton rejects Descartes' filled space in favor of an empty "volumetric space," he suggests that he is going back to the Bible and to
Pythagoras, Thales and Anaxagoras — to the Presocratics we studied in Chapter I. Newton seemed to believe that Solomon's Temple was a microscopic model of God's universe, and this is why he so carefully reconstructed it. Here is something of what Lord Keynes saw as Newton the "mystic-magician." The Puritan ancients did have secret truth worth discovering.

There are also signs of types of rationalism in Newton, which we ought to expect of any informed man writing in seventeenth century England. We shall see that Newton's early discussion of space was metaphysical, although later in life he lost interest in this aspect of the problem of space and time. There are also signs that Newton tended too easily to reduce doctrines of the Christian faith, although much of this can be explained in terms of his Puritan doctrine of the church. Westfall tries to explain everything in terms of Newton's rationalism, but to treat Newton's theology apart from his doctrine of the church, as Westfall (and the Unitarians) do, is extremely misleading to say the least.

Perhaps the most fundamental aspect of Newton's rationalism has yet to be explored. Historians of science and philosophers have not sufficiently, in our opinion, come to grips with the way in which Newton used mathematics in his physics. This is an important problem, which we will leave more or less unexplored. If we remember that mathematics, and geometry in particular, was fundamental to Newton's Principia and his Optics, and also that the rationalism of Plato, the logic of Aristotle, and the rationalism of Descartes, Leibniz and Spinoza took mathematics, and geometry as its epistemological model, then we have to ask, Was not Newton influenced by rationalism in a way

---147---

1 Newton, Principia, "General Scholium," note, p. 545.
which shared common roots with philosophy? Did this not lead in effect to a "mechanical" view of the universe?

The interesting way in which Newton attempts to verify the Christian religion through a study of Biblical Prophecy (prediction) and historical fulfilment actually treats history as simply a series of events ordered chronologically. Of course, history during the time of Newton was mainly a problem of chronological dating. But one almost suspects that history is mechanical for Newton, and that eschatological fulfilment in history is also mechanical, and to a certain extent "predestined;" in other words, it can be argued that a type of determinism in Newton's physics and in his historicoc-prophetic theology tend to re-enforce each other. In Newton's study of biblical prophecy, one sometimes suspects that it is more important that an event happen on the right date than to investigate the contents of the event itself.

We also wonder to what extent the concept of "prediction" and "fulfilment" as it is understood in science influenced Newton's theology. In simple terms, if a physicist "predicts" that a body will accelerate toward the earth at the rate of 32 feet per second per second, and then experimental evidence shows that in fact the rate is 320 feet per second per second, the physicist's theory will have been falsified rather than verified. In considering the problem of the Incarnation of Christ Newton once commented, "The Jews did not expect their Messiah to be more than a man, yet freely called him the Son of God."¹ If as in science we attempt to apply a one to one correlation between

prediction and fulfilment in the Bible, then to suggest that whereas the Jews expected Christ to be a man, if instead he turned out to be more than a man, this would tend to falsify the prediction. This may help explain Newton's Arianism. Perhaps Newton has not considered the biblical notion that God rewards sevenfold, that his "fulfilment" goes beyond "predicted" expectations.¹

Newton's theological work is sometimes ordered according to short "theses" or "statements" or "queries," all of which remind one of geometric corollaries or theorems.² This may have been an unconscious product of Newton's orderly thought, but it could be cited as an example of the influence of rationalism on Newton, and this type of material has been ignored by Westfall and others up to the present time.

We cite this material because we are not trying to prove that Newton was not influenced by mysticism or by rationalism. We do suggest, however, that he was consciously trying to be something like an "empiricist" in both his science and his theology. This is why he rejected metaphysics and philosophy, and in fact, if Newton had been less hostile toward philosophy, he might have seen that he unconsciously held many presuppositions which needed metaphysical criticism. We might say that Newton's empiricism was his weakness — as well as his strength. He was perhaps less critical of his own method and work than he might have been. But it is rather presumptuous to stand in judgment over Newton. We would rather examine than judge him. And having pointed to some of the problems which we have found in Newton, we will now turn to an

¹ Cf. Is. 30: 26 etc.

examination of some aspects of the concepts of time and space in Newton's scientific thought, and then we shall examine, in chapter IV, Newton's theology, and the eschatological implications of his concepts of time and space. We hope this examination will throw some new light on the broader questions related to Newton's religious personality, and on the question of the relation between Newton's science and theology.

B) The Background to Newton's Scientific Work

We shall investigate five aspects of the background to Newton's scientific work. 1) Newton's relation to the Cambridge Platonists -- Henry More's idea of space; 2) Isaac Barrow and Newton's mathematical education -- mathematical formula; 3) Robert Boyle and experimental method -- empirical verification; 4) René Descartes and the cosmological synthesis; 5) Eschatology, time and space in Newton's science.

1) Newton's Relation to the Cambridge Platonists -- Henry More's Idea of Space

Newton received his preparation for Cambridge at Old King's School at Grantham; his Headmaster, Henry Stokes, apparently had a high regard for Newton. While at Grantham Newton lodged with a Dr. Clark who was a nephew and a student of Henry More at Christ College, Cambridge. And we know from a letter by More written in 1630 that already Newton had spoken with More about the latter's *Exposition of the Apocalypse*. More's main interest in the Apocalypse, however, was to show, among other things, that it was essentially "reasonable." He was concerned with the "reasonableness" of the idea that the earth would be consumed by fire in the last days -- there were so many things on it which would burn, like wood and coal. Tuveson

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2Ibid., p. 629.
points out that More had a strong influence on Thomas Burnet, one of many rationalists who sought to reconcile reason and religion, which they understood to be science and Scripture. And later we shall find Newton writing to Burnet concerning the Mosaic creation.

Perhaps the main distinctive concept which More gave to British philosophy was his concept of Space, his dualism between space and body. More was tremendously influenced by Descartes, and in his early years eagerly embraced the Cartesian philosophy. But as its mechanistic implications began to make their impression on More, he eventually rejected the Cartesian identification of space and body, as we saw it developed in the Principles, and substituted for it a dualism of Space and Body or matter. More identified the world of "space" with the world of "Spirit" and in this way gave apparent scientific grounds for belief in such a dualism, although his basis for this distinction was rationalistic. What is interesting is to see that Descartes was essentially Aristotelian in his identification of space and body, both being composed of extension. And More, being a Platonist, held a dualism between Space as Volume as we have described it above, and Body as contained in space but separate from it. But it is important to remember that both Descartes and More were rationalists — they simply belonged to two different schools of philosophy. More took the next logical step and identified Space with God, for he found they had much in common. A major study of More's idea of space is found in the work by John Tull Baker, An Historical and

---151---

Tuveson, Millennium, p. 113 ff.

J.E. Saveson, "Differing Reactions to Descartes Among the Cambridge Platonists," Journal of the History of Ideas, Vol. 21, pp. 560-567, says that Descartes' mechanism is for More "the most unacceptable part of the Cartesian philosophy" (p. 560). To combat mechanism More elevates the soul — Newton has almost no interest in the human soul.
Critical Examination of English Space and Time Theories from Henry More to Bishop Berkeley. Baker treats six men who he believes stand on common ground in English thought: Henry More, Isaac Barrow, Isaac Newton, John Locke, Samuel Clarke, and Bishop Samuel Berkeley. This is an adequate work within the limits he has set, but because of the fact that Baker rightly makes Newton's concepts pivotal, the work has certain weaknesses. 1) It will be obvious in due course that the main stimulus to Newton was his opposition to Descartes directly, not via Henry More, and that Newton, although he shared the conclusions of More, arrived at them on empirical, not philosophical, grounds. It can be misleading that More and Newton seem to share a common ending point if their method of arriving at that end is ignored. When we come to Baker's treatment of Newton, we see the essential weakness of his treatise. He says, "it does not seem improbable to assume, when we remember that Barrow was Newton's tutor, that Newton was thoroughly familiar with the work not only of Barrow but of More." 2) In all the work that we have seen concerning Newton's concept of space, he never once mentions More's name. 3)

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3 A.R. Hall, "Sir Isaac Newton's Notebook, 1661-1665," Cambridge Historical Journal, Vol. 9, pp. 239-250, has found that Newton took notes from Henry More's work "On the Immortality of the Soul" (London, 1659); p. 243. DeVillamil, Newton, in his catalogue of Newton's library found that Newton owned the 1688 edition of this work. What is more interesting, however, is that Hall mentions nothing from Newton's notebook concerning More's concept of space, and DeVillamil lists only two other works in Newton's library, More's "On the Prophet Daniel" (1681) and his "On the Revelations" (1680). None of More's Platonic work is listed! These are the only three works by More found in Newton's library. Newton seems to have had little interest in More's philosophical work, although we do suppose he was aware, at least indirectly, of More's concept of space; DeVillamil, Newton, p. 87.
2) Baker might have changed his opinion concerning the method by which Newton arrived at his concept of space if he had seen the recently published article by Newton, "De Gravitatione," which is a critique of Descartes' identification of space and body. This article will be considered below. More was trying to oppose the atheism implied in the Cartesian machine. One of the interesting elements in the view expressed by More is that both God and Space necessarily exist, a form of Anselm's ontological argument applied to space. More thus develops a concept of space which is both metaphysical and mystical. What do God and space have in common? In his *Enchiridion Metaphysicum* (1671) More says,

this infinite and immobile space which is so certainly discerned in the nature of things will seem [as we shall finally note] to be something not merely real but divine. [This will be manifest] after we have enumerated those divine names and titles which precisely harmonize with it; and these titles will create strange confidence that [the reality] to which so many splendid attributes belong cannot be a nothing. [The attributes of which I speak] are these which follow which severally belong to Metaphysical Primal Being. As, Unum, Simplex, Immobile, Asternum, Completum, Independens, A se existence, Per se subsistens, Incorruptibile, Necessarium, Immensum, Increatum, Incircumscriptum, Incomprehensible, Omnipresent, Omnipresens, Incorporeum, Omnia permeans et complectens, Ens per Essentiam, Ens actu, Purus Actus. There are no fewer than twenty epithets by which the divine Deity is wont to be described which harmonize most exactly with this infinite internal place which we have demonstrated to exist in the nature of things.  

Perhaps one of the best analyses of More's over-all work is by F.I. MacKinnon.  


1 Henry More, *Enchiridion Metaphysicum* (London; 1671), Chapter 8, Section 8; cited by Baker, *English Space*, p. 12, from an unpublished translation by Mary Whiton Calkins.


seems never to have been any doubt about his rationalism.

Almost none of More's philosophical work is in Newton's library. Newton does have, however, eight pages of unpublished notes probably from Ralph Cudworth's *The True Intellectual System of the Universe* (1678). Cudworth tries to combat the lifeless machine of Descartes by describing a "Plastic Nature," adopting something like a "world-soul" and speaking of the universe as the sensorium of God. Newton raised a query concerning the relation of the sensorium to Space, much like the Platonic conception described in our first chapter in which the head of man acts as the seat of his soul, so space seems to be the seat of the world-soul. But Newton could not accept Cudworth uncritically because Cudworth, (like Leibniz, whose monads have much in common with Cudworth's "Plastic Nature") was driven to believe that space and time were essentially unreal. The precise opposite is true for Newton. The sort of speculation which was put in Query form by Newton in his *Optics* is an essentially atypical comment.

2) Isaac Barrow and Newton's Mathematical Education — Mathematical Formula

We hesitate to present an estimate of Newton as a mathematician. This is essentially a task for the historian of science specially trained in mathematics; nevertheless, if what we suspect is true, if Newton is an empiricist in his theology just as truly as in his science, then we must examine the roots of the type of empiricism which Newton practised in his science.

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1 Sotheby, *Catalogue*, No. 233, p. 65, lists "Extracts, 'Out of Cudworth.'

2 Cf. above Chapt. I, pp. 34-47. In his *Optics* Newton speaks of God "who, being in all places, is more able by his will to move the bodies within his boundless uniform sensorium," but he is careful to say, "And yet we are not to consider the world as the body of God," Newton, *Optics, Opera*, Vol. IV, p. 262. To speak of space as a sensorium, however, does remind one of material in the *Timaeus*. 
Newton began his University studies at Trinity College, Cambridge, in June of 1661. His talent for mathematics apparently did not appear immediately, although mathematics and logic would be included in his Classical education. H.W. Turnbull has given perhaps the best short discussion of Newton's mathematics in his work, Mathematical Discoveries of Newton. He points out Newton's debt to Oughtred and Wallis; particularly important was the notation developed by the latter.¹ But there is no doubt that the most important influence on the development of Newton came from Isaac Barrow who became Newton's tutor in 1663.² Barrow made certain that Newton mastered Euclid, probably Archimedes, as well as the Geometry of Descartes and the work of Oughtred and Wallis.

Barrow was a mathematician of very creditable skill. Turnbull says of Barrow's work,

The Lectiones Geometricae which met with such a paltry reception were nevertheless a systematic account, in a geometrical idiom, of both the differential and the integral calculus. They fulfil the subtitle of the lectures by "specially declaring the general symptoms of curve lines". They begin with a highly interesting philosophical discussion of time ("the continuance of any thing in its own being") and of variable magnitudes, and they quickly go on to consider a curve as the locus of a moving point.³

Baker maintains that it is from this discussion of time by Barrow that Newton arrives at his concept of Absolute time.⁴ This is justified to some extent, although the concept of Absolute time, we shall see, really results from Newton's whole scientific method. In his discussion of time Barrow had observed that time has much in common with a line (he follows Aristotle

²L.T. More, Newton, p. 35. ³Turnbull, Mathematical, p. 11.
⁴Baker, English Space, points out that Barrow saw time as an attribute of God (p. 16-17). Newton will accept this general conclusion about the relation of space and time to God.
The similarity is that time "can be looked upon as constituted from a simple addition of successive instants or as from a continuous flow of one instant," and likewise a line "can be looked upon as being made up of an infinite number of points or as the trace of a moving point."¹

Descartes' analytical geometry had shown that time can be spatialized or can be introduced as a numerical element in an algebraic equation, and so to quite an extent the stage had already been set for Newton to develop the calculus. In fact, J.M. Child in his article, "Barrow, Newton and Leibniz in their Relation to the Discovery of the Calculus"² has maintained that both Newton and Leibniz essentially owe their success to the previous efforts of Barrow. We must note that Barrow's lectures point back to the problem of Zeno's paradox which we met in Aristotle's Physica.³ And M.G. Evans in his article "Aristotle, Newton, and the Theory of Continuous Magnitude" has shown that Newton rejected the "addition" concept for the "flowing" concept.

The important advance of Newton was that whereas "previous investigators had treated the area under a curve as an aggregate of parallel lines, Newton inverted the procedure, and treated the area, not as an aggregate of lines, but as a function of the rate of growth, or momentary increase, at a point." Then to use modern terminology Evans continues "Thus, given the curve, \( y = f(x) \), the rate of increase in the area at any point under that curve will be equal to the height, \( y \), of the curve at that point. That is to say, \( \frac{dA}{dx} = y \); whence \( A = \int y \, dx \)."⁴


³ Cf. above Chapt. I, pp. 51 ff.

This analysis is described in terms of Cartesian co-ordinates, and the notation is that developed by Leibniz. Newton's notation was slightly more cumbersome than that of Leibniz, although it served its purposes. We would only comment here that Newton solved in a very practical way a paradox which seemed impossible to resolve by philosophical rationalism. Furthermore, this problem of a flowing point sounds in many ways like one of Leibniz's monads, and when we remember that in Newton's Principia he made the operational decision to treat all celestial bodies as if their mass were concentrated at their geometrical centre point (an operational practice still used by physicists), we can see how the calculus would be of extremely practical value in treating the motion of heavenly bodies, and developing the theory of gravitation. And it is possible to conjecture that Newton used the calculus to develop his Principia, at least in some parts, and then later presented it in its final geometrical form in Book I. It has been suggested that Newton would not use the calculus in his public presentation because it too was a new science, and it would hardly do to use an unknown science to prove another unknown science.

It is perhaps not too premature to begin to look back at some of Keynes' statements concerning Newton as a mystical "magician." One of the bits of evidence which Keynes uses to support his thesis is the fact that Newton sent his discovery of the calculus to Leibniz disguised in a cryptogram, which supposedly shows that Newton saw the whole universe as a dark mystery. More has pointed out that the so called epistola posterior from Newton to Leibniz apparently was not even a code which could be broken. The real issue at stake

3Keynes, "Newton," p. 29.
here was who would get credit for the discovery of the calculus, Newton or
Leibniz; this was before the days of copyright laws, and all through his
life Newton was accused of stealing his ideas from others, when it was usually
the reverse procedure. Newton’s motive for the cryptogram was extremely
practical to say the least, and not at all evidence which can show Newton
was a mystic.\(^1\) We should note also that what has happened here is basically
a misunderstanding by Keynes of the role of symbolism in mathematical work.
We shall return to this point many times.

Furthermore, in reference to Newton’s use of mathematics in the *Principia*
Keynes had said,

Certainly there can be no doubt that the peculiar geometrical form in
which the exposition of the *Principia* is dressed up bears no resemblance
at all to the mental processes by which Newton actually arrived at his
conclusions.\(^2\)

If what Keynes says is true, it ought to be noticed that as we have
suggested Newton could have used the calculus to carry out his explorations
and then have given the work its final geometrical form. Keynes takes a most
unusual approach here, for first he claims that Newton’s mathematics had
nothing to do with his discoveries, and then he says, "His experiments were
always, I suspect, a means, not of discovery, but always of verifying what
he already knew."\(^3\) To suggest that Newton used neither mathematics nor
experiments in his science is indeed remarkable.

Turnbull suggests that Newton discovered and wrote the Binomial Theorem
in 1664;\(^4\) his Method of Fluxions (the Calculus) between 1665 and 1666;\(^5\)

\(^2\) Keynes, "Newton," p. 29.
\(^3\) Ibid.
\(^4\) Turnbull, *Mathematical*, pp. 12-13; for many of Newton’s mathematical
De Analyti, a means of integrating fractional powers, in 1669; De Quadratura, which is a refinement on the calculus, about 1674; the Geometria Analytica, about 1670, a supplement to Descartes' work and to his calculus; mathematical analysis of solids of least resistance and curves of quickest descent, used in the Principia; especially Book II; formulas for Angular Sections, problems in trigonometry; the process of interpolation of curves from their formula; his algebraic work in his Arithmetica Universalis, first published in 1707; his treatment of cubic curves is concerned with geometrical conics; and then the geometry of the Principia itself. The latter would have been impossible without the former, and it is clear that if Newton had never written the Principia, he would still be remembered to this day for his mathematical work.

Turnbull summarizes the importance of Newton's mathematical work in this way:

Gregory was right when he stated, in the preface to the Geometriae Pars Universalis, that the true division of mathematics was not into geometry and arithmetic but into the universal and the particular. Through the genius of Newton and his contemporaries this passage from particular problems to universal methods was once and for all effected. The great step consisted in discovering, asserting and practising the three related analytical operations of expansion, differentiation and integration.

If Newton's success in pure mathematics can be traced back to Barrow, so too Newton owes something to him in the experimental realm. In Barrow's

\[\text{1 Ibid., pp. 22-27.} \]
\[\text{2 Ibid., pp. 27-33.} \]
\[\text{3 Ibid., pp. 34-39.} \]
\[\text{4 Ibid., pp. 39-42} \]
\[\text{5 Ibid., pp. 43-45.} \]
\[\text{6 Ibid., pp. 46-48.} \]
\[\text{7 Ibid., pp. 43-52.} \]
\[\text{8 Ibid., pp. 52-54.} \]
\[\text{9 Ibid., pp. 54-59.} \]
\[\text{10 Ibid., p. 61.} \]
college oration of 1659 he had accused Descartes of paying too little attention
to the results of experiments.¹ Barrow did not lecture only in pure mathemat-
cics, he also applied geometry to an experimental analysis of light,
publishing his Opti cal Lectures in 1669, the year in which he resigned his
position as Lucasian Professor of Mathematics, recommending his pupil Newton,
whom he now considered superior to himself, to succeed him at the age of twenty
seven as the new Lucasian Professor at Trinity. Barrow then devoted himself
entirely to theology, becoming Master of Trinity in 1672 until his premature
death in 1677.² It should be noted that in a nine volume edition of Barrow's
Works, no less than three volumes are devoted to a systematic treatment in
sermons of the Apostles' Creed; Newton undoubtedly heard these sermons, and
we shall find that it is precisely this Creed which is central to Newton's
personal faith.³

It might generally be said that historians of science have emphasized
the mathematical side of Newton to the neglect of his experimental method.
This will become more apparent as we proceed. And it is for this reason that
we find the article by E.W. Strong, "Newton's Mathematical Way" so important.
Strong emphasizes that Newton's mathematics did not play simply an a priori
role in his science, it also had an experimental role.

This procedure with respect to the role of measurement in experimental
inquiry can be called mathematical experimentalism, and, with respect
to reasoning from principles, mathematical demonstration.⁴

¹Lichtenstein, Henry More, p. 124, n.
²L.T. More, Newton, pp. 33, 81.
³Isaac Barrow, Theological Works, (ed.) Alexander Napier (Cambridge: 1859),
see especially Vol. 7 ff. on the Creed.
Ideas, Vol. 12, p. 90.
Strong points out that E.A. Burtt must argue that there is
an unreconciled conflict in Newton's thought between his mathematical
rationalism, on the one hand, and his empiricism, on the other. Neither
critic, however, has done justice to Newton's statements about measure-
ment and its role in the formulation of principles.¹

He also maintains that Newton rejects Descartes' a priori rationalism
in mathematics and maintains that mathematical ideas need to be tested by
experience.² There is some unpublished evidence to support this opinion.
Among Newton's scientific papers at the Cambridge University is one which
contains notes in reference to Newton's mathematical method. He notes that
the truth of arithmetic, geometry, and mechanics depend on the truth of their
axioms, postulates, and theorems.³ One does not accept their truth without
some sort of test. He says,

¹Ibid., pp. 90-91.

²Ibid., p. 110; the question of the place in physics of "mathematics"
and "metaphysics" is an extremely delicate one, and it will be of general
concern throughout our treatment of Newton, especially when considering his
concepts of "Absolute" time and space. Stephen Toulmin in his article
"Criticism in the History of Science: Newton on Absolute, Space, Time, and
Motion," Philosophical Review, Vol. 68, pp. 1-29, 203-227, seems to argue
that absolute space and time were a priori starting points for Newton, whereas
Dudley Shapere in his article "Mathematical Ideals and Metaphysical Concepts,"
Philosophical Review, Vol. 69, pp. 576-385, answers Toulmin by suggesting that
Newton's absolute concepts were at that time what Newton believed to be
empirical standards of measurement, but are for this reason open to empirical
objections. Newton's use of space and time involves a scientific procedural
principle, which has since been abandoned.

³Cambridge University Library Catalogue MSS No. C.U.L. Add 3963, See
A Catalogue of the Portsmouth Collection of Books and Papers Written by or
Belonging to Sir Isaac Newton: The Scientific Portion of Which Has Been
Presented By the Earl of Portsmouth to the University of Cambridge, (Cambridge:
At the University Press, 1888), Sect. I, 6, p. 4.
Scientiarum mathematicarum methodus est duplex, synthesis et analysis, vel compositio et Resolutio.¹

This in a sentence is also his scientific method, mathematical synthesis and empirical analysis. Also among his scattered notes is the sentence, "Unum est res omnis absolute et per se spectata."² This is why his mathematical formulae, as we shall see, are called absolute. Mathematics is based on unity, and unity is an absolute. Here also is a possible root of his practical atomism. To treat the universe mathematically, if one considers unity as an absolute in mathematics, is almost to commit oneself by definition to at least a pragmatic atomism, which Newton does. And he sees mechanics as a science which combines the sciences of arithmetic, geometry and mathematics.³

3) Robert Boyle and Newton's "Experimental" Education — Empirical Verification

There can be no doubt that many men ranging from Francis Bacon to Robert Hooke influenced Newton's experimental method. Philip E.B. Jourdain in his article, "Galileo and Newton" has shown that Newton owes a considerable debt to Galileo in the field of mechanics and mathematics.⁴ Francis Bacon was a man whose influence eventually led to the founding of the Royal Society, of which Newton was to become president. Robert Hooke performed experiments for the Royal Society at numerous meetings, and had done valuable work in the study of light; and it is probably only due to the personal quarrel between Newton and Hooke which resulted in the omission by Newton of any mention of indebtedness to Hooke in publishing his Optics (1704), the year after Hooke's

¹Ibid.

²Ibid.

³Ibid.; Hall, "Newton's Notebook," p. 24; finds Newton asking concerning atoms "Whether it be mathematicall points: or mathematicall points & parts: or a simple entity before division indistinct: or individually or Atomes." Newton accepts the last alternative. Cf. also Principia, p. 399; also Optics, Opera, Vol. IV, pp. 260 ff.

death. In the *Principia* Newton mentions Hooke as one who had suggested the "gravitational attraction" theory of planetary motion. If Hooke did have the misfortune of making many important discoveries, only to have them apparently adopted by Newton, the fact remains that Hooke did not have the patience methodically to carry out any such program as we find in Newton's *Principia*.

When we turn to Newton's personal library, we find one work by Francis Bacon, one work by Galileo, two volumes by Hooke, and twenty three volumes by Robert Boyle which include among others, *Spring of the Air and its Effects* (1660), *Usefulness of Experimental Philosophy* (1664), *Experiments Physico-Mechanica* (1680), *Sceptical Chymist* (1680), and *Natural Philosophy in an Experimental Way* (1691).

Newton saw the results of experiment as not only important for proving his theories, but also in gathering evidence on which to base the formulation itself. The important historians of science such as Andrade, I.B. Cohen, M.B. and A.R. Hall, and A. Koyré would all agree that experiments were fundamental to Newton's science, and they would all disagree with the Keynes' analysis of Newton as a scientist. In order to make Newton out to be an integrated personality, Keynes, to support his "mystic" theory, had to abstract Newton from nature. In Newton's fourth Rule of Reasoning in *Philosophy* we read:

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1Andrade, *Newton*, p. 63.
In experimental philosophy we are to look upon propositions inferred by general induction from phenomena as accurately or very nearly true, notwithstanding any contrary hypothesis that may be imagined, till such time as other phenomena occur, by which they may either be made more accurate, or liable to exceptions. 1

And the opening words of Newton's Optics are:

My Design in this Book is not to explain the Properties of Light by Hypotheses, but to propose and prove them by Reason and Experiments. 2

The words "Reason" and "Experiments" point to the dualism in Newton's scientific method; he does not work on "Reason" alone, but moves back and forth between reason and experiment. And all of Newton's work exhibits this dualism. Where did he develop this dualism? Certainly it was part of the atmosphere at Cambridge, but we are convinced that Newton's main inspiration was Robert Boyle. It was Boyle's method in physics and chemistry which caught Newton's attention, and eventually led him from the study of light to the solar system itself. It has been our experience in this study that the one area of Newton's work which has been most neglected is that of his experimental method. 3

1Newton, Principia, p. 400.

2Newton, Optics, Opera, Vol. IV, p. 5.

3Up to the present time there has been no definitive study of the way in which Newton received his "laboratory" education. Was he totally self-taught? Perhaps, in the sense that he learned from reading the works of others, and we would say that he read Boyle in particular. The only way in which this question can be settled is for a scientist to make a thorough study of the notes and experiments which Newton made (now in the Cambridge University Library) which he had no intention of publishing. Every scientist works in his experiments by trial and error, and when we say that we have not seen a thorough study of Newton's scientific experimental method, we are suggesting that such a study would have as much to say about the mistakes which Newton made as about his successes. John Herivel's recent work, The Background to Newton's 'Principia': A Study of Newton's Dynamical Researches in the Years 1664-84 (Oxford: At the Clarendon Press, 1965), is a step in the right direction, although there would seem to be room for more work to be done.
In 1953 [ed.], Cohen edited a volume entitled *Isaac Newton's Papers and Letters on Natural Philosophy,* which provides a useful summary of the letters and papers by Newton "on the improvement of the telescope and on physical optics," and also a section on Newton's "chemistry, atomism, aether, and heat," but none of this material is really new, only the collection is new. In 1962, however, A.R. and M.B. Hall published perhaps one of the most useful modern supplements to our knowledge of Newton in their work, *Unpublished Scientific Papers of Isaac Newton,* a work containing several short, important papers from the Portsmouth Collection in the Cambridge University Library. The papers presented, however, were all prepared to a certain extent by Newton in a systematic way. We do not get a glimpse in this work of the "trial and error" procedure which Newton must have practised in his experimental science. We get the impression that Newton's thoughts were nearly always systematic, even in their "formative" stage. What is clear from both the publication by Cohen and Hall is that Robert Boyle seemed to play a very important role in Newton's scientific work. Everyone agrees, of course, that Boyle influenced Newton. Everyone agrees that Newton undoubtedly shared his interest in alchemy with Boyle, and that Newton was aware of Boyle's experimental work, especially of his work with air and other gases. But what we have not seen clearly stated by anyone is whether or not the very fact that Newton was an experimentalist of a certain type does not owe itself directly to Boyle. We can only suggest that this may be so.

---165---

After carefully studying Newton's notebook which was written during his student years at Cambridge, A.R. Hall observed, "One point at least is beyond doubt on the evidence of this notebook, the two writers who exercised the greatest influence on Newton at this time were Descartes and Boyle."\(^1\) Descartes inspired in Newton the desire to construct a cosmological synthesis, and the importance of this fact must be kept in mind. Hall has found many references in Newton's notebook to Descartes' *Principles*,\(^2\) and when we examine "De Gravitatione" we shall see that the *Principles* of Descartes was the stimulus behind Newton's thought.

It is perhaps of some significance that a close friend of Newton, John Craig, in the year in which Newton died said of the relation between Newton's scientific and theological work:

I shall not tell you what great improvements he made in geometry and algebra, but ... his inquiries into nature did not make him unmindful of the Great Author of nature ... And this I know, that he was much more solicitous in his inquiries into religion than into natural philosophy, and that the reason of his showing the errors of Cartes' philosophy was, because he thought it was made on purpose to be the foundation of infidelity.\(^3\)

Descartes' influence on Newton was both positive and negative. He inspired Newton to think in cosmological terms, but the theological implications of Descartes' work made Newton determined to undermine it.\(^4\)

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\(^1\) Hall, "Newton's Notebook," p. 243.


\(^4\) For a good discussion of the relation between Newton and Descartes see Alexandre Koyre, "Newton and Descartes," *Newtonian Studies*, Chapt. III, (London: Chapman and Hall, 1965), pp. 53-114. Koyre notes that "we see that Newton's anti-Cartesianism is not purely scientific; it is also religious" (p. 109). See also Hervel, *Background to Newton's 'Principia'*; Descartes and Newton, pp. 42-53; Newton's aversion to Descartes, pp. 42, 53.
5) Eschatology, Time and Space in Newton's Science

When we suggest that Newton's science is "eschatological," we mean that "prediction" is important to Newton as a means of verification. What we mean is that the function of Newton's mathematical equations or theories is to "predict" that under certain circumstances an event of a particular sort will occur. Scientists generally agree that the function of science is to arrive at theories or "predictive hypotheses" which can be empirically tested, and this is what we mean by eschatological. Eschatology looks to the future and to potential "fulfilment." Science works on the hope that its equations will predict the fulfilment of future natural events.

To a certain extent it is "reading a concept back into Newton" to talk about the role of prediction in his science. But modern discussion of the nature of scientific method seems to agree that prediction is intimately related to the process of experimental verification. The role of prediction in science can be complex. One may have a scientific theory that "the sun will rise tomorrow," and if the sun "rises," then to a certain extent one's theory will have been verified. If one says, "the sun will always rise every day," the situation becomes more complex. An infinite number of fulfilled predictions may be necessary to verify this statement. Science, however, builds on the body of material already tested. As Popper notes,

With the help of other statements, previously accepted, certain singular statements -- which we may call "predictions" -- are deduced from the theory; especially predictions that are easily testable or applicable.

1 Karl R. Popper, The Logic of Scientific Discovery (London: Hutchinson, & Co. Ltd., 1959), p. 33; R.E. Mascall has noted some of Popper's work on "prediction," and has shown that there is a considerable element of indeterminacy in prediction in classical physics, and in fact, has suggested that "it is inherently impossible to devise a machine by which a future state could be even approximately calculated before it had in fact occurred" (Mascall, Christian Theology, p. 185). In natural science, in fact, verification takes place after the experiment has been performed. This will be important to keep in mind when we come to Newton's historico-prophetic theology, for this will be exactly the case with historic predictions.
Depending on whether a prediction is fulfilled or not, so is the theory verified or falsified. When a universal law is developed in science, as Newton's law of gravitation, it is not seen by science as an absolute law, but rather one which has a high degree of predictive fulfilment — it has not yet been contradicted. But some day an exception to the rule may be found, and therefore scientific laws only exhibit a high degree of probability, not absolute certainty. This concept is seen in Newton's fourth Rule of Reasoning:

In experimental philosophy we are to look upon propositions inferred by general induction from phenomena as accurately or very nearly true, not-withstanding any contrary hypotheses that may be imagined, till such time as other phenomena occur, by which they may either be made more accurate, or liable to exceptions.

The key phrase here is "till such time;" Newton's empirical science must always face the threat of time, and here it differs from the work of Descartes. New elements may be discovered in nature as time passes, which will undermine Newton's conclusions. His predictions may not always be fulfilled. Furthermore, there are the contingencies involved in carrying out an experiment.

Consider the way Newton demonstrates Prop. II. Theor. II of his Optics, "The light of the Sun consists of rays differently refrangible." The experiment begins,

In a very dark chamber, at a round hole, about one-third part of an inch broad, made in the shut of a window, I placed a glass prism, whereby the beam of the sun's light, which came in at the hole, might be refracted upwards toward the opposite wall of the chamber, and there form a coloured Image of the sun.

\(^1\) Cf. Hans Reichenbach, Experience and Prediction: An Analysis of the Structure of Knowledge (Chicago: Chicago University Press, Phoenix edition, 1961), "Verifiability theory of meaning," (pp. 46-80), which leads to a "probability" theory of truth (pp. 297-404). Predictions are always extremely contingent (p. 55).

\(^2\) Newton, Principia, p. 400; cf. also Optics, Opera, Vol. IV, p. 5.

\(^3\) Newton, Optics, Opera, Vol. IV, p. 21.
One of the difficulties Newton faced was that many of his fellow scientists found it difficult to reproduce his experiments, and this should not surprise us, for there are many contingent elements even in this introductory sentence. How dark need the chamber be? How evenly round need the hole be? What angle was the sun in the sky? What time of year and day? What type of glass was in the prism? What shape is the prism? What are the dimensions of the room? What are the colours of the walls of the room? How adequate is the observer's (Newton's) colour vision? Newton presents his experiments assuming that if properly reproduced, the same results he found will follow. He predicts that under the right circumstances, Prop. II. Theor. II. will be verified. This is Newton's idea of how science should function inductively — but it is an extremely difficult method, to say the least.

Newton consciously attempted to remove metaphysics from his science, but one of his rules was "to the same natural effects we must, as far as possible, assign the same causes."¹ This is a metaphysical concept, one which cannot be verified empirically, although Popper admits that the principle of causality is the basis of science. Popper observes, "The 'principle of causality' is the assertion that any event whatsoever can be causally explained — that it can be deductively predicted."² Popper then gives his metaphysical version of the law of causality:

"It is the simple rule that we are not to abandon the search for universal laws and for a coherent theoretical system, nor ever give up our attempts to explain causally any kind of event we can describe."³

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¹Newton, Principia, p. 398.
²Popper, Logic of Scientific, p. 61.
³Ibid.
He even suggests that positivists such as Wittgenstein who completely reject metaphysics also reject science, "For scientific laws, too, cannot be logically reduced to elementary statements of experience." ¹

Newton did not completely escape from metaphysics, and yet this does not concern us, for we are not seeking to make him into a "positivist" or a "radical empiricist" in the light of modern debate. What we do insist, however, is that Newton attempted to derive his scientific laws inductively from experience and experiment. After they were derived, he insisted that his laws be empirically tested. Newton's "metaphysical principle" was that we are to derive our knowledge from nature. He did not begin, as did Descartes, with the cogito principle. Newton's laws were more than logical; they stood or fell depending on their ability to predict physical phenomena. If his laws failed, they had to be discarded.

Thus time was necessary for Newton's science in the first place as the continuum within which verification took place. But Newton's science involved measurement not only of time, but also of space, since both are related to motion. The concepts of time and space were fundamental to his physics, and it is not surprising to find that Newton paid careful attention to both concepts. ¹) We shall investigate Newton's ontological understanding of the nature of time and space. We shall find that the "being" of time and space is constituted by the existence of God. In his "De Gravitatione" Newton discusses both the theological and physical implications of time and space, in the light of Descartes' Principles, but by the time Newton published the first edition of the Principia, he had separated his theology from his physics,

¹Newton, Principia, p. 393.
and it was only in the second edition that he added a "General Scholium" which discussed the relation of God to time and space. We see the relation between God, time and space as an essentially ontological problem. 2) We shall investigate also the epistemological role of time and space in Newton's science. Here we have in mind the distinction between Absolute and Relative space and time which Newton set forth in the introductory Scholium to his Principia. The distinction between Absolute and Relative is one between knowledge and experience, between theory and experiment, between mathematical formula and experimental measurement. It is here that the "predictive" element in Newton's science rests, for Newton's "Absolute Theory" tends to predict certain "Relative Experiments" which will verify or falsify his theories. In Newton's theology we shall find that Newton in similar fashion takes "biblical prophetic theory" and compares it with "historical experimental fulfilment," and thus seeks to verify the Christian religion. It is by a consistent application of his method of verification in science and theology that we have been led to point to "empirical" elements in both disciplines. We shall first attack the "ontological" problems related to time and space in Newton's science, and then we shall turn to the "epistemological" aspects of time and space. We hope that by distinguishing between ontological and epistemological aspects of Newton's thought that the issues may be more clearly seen.

C) Newton's Ontological Dualism Between Space (Volume) and Body (Mass)

We have divided the problem of Newton's ontological understanding of space and time, and their relation to God and Creation, into two sections. 1) We shall take Newton's "De Gravitatione et Aequipondio Fluidorum" as the embryonic statement of Newton's theological and scientific ontology. We shall also consider the problem of the "aether" in Newton's science, in the light of his letter to
Boyle, and we shall also consider the concept of the "Spirit of God" in relation to creation on the basis of Newton's letter to Thomas Burnet. We shall simply try to point at the highlights in Newton's thought, for a complete analysis of the problems we shall confront would require far too much space.

2) After seeing how Newton develops his ontological understanding of the relation between God, Time, Space and Creation, we shall examine the General Scholium to the Principia as a mature summary of Newton's ontology. This was written when Newton was seventy one years old. The whole problem of Newton's "ontology" is extremely complex, not only because Newton does not develop his ideas completely and consistently, but also it appears that many of his ideas were a reaction against some other ideas, rather than simply an ontology which Newton sought to work out voluntarily. Furthermore, there may be some confusion as to why we should speak of "ontology;" we think that it is more appropriate and less misleading than the term "metaphysics."

1) Newton's "De Gravitatione" -- His Early Ontology

Hall is of the opinion that "De Gravitatione" was written while Newton was a student at Cambridge, and that it may be dated between 1664 and 1668. Hall says that this paper appears to spring from Newton's critical reaction to the Principia Philosophiae of Descartes. This is indicated by the first few lines of 'The Lawes of Motion', and by its attempt to analyse the motions of bodies after impact, which played so large a role in Cartesian physics. It is obvious throughout No. 1 [De Gravitatione], even without the explicit references to Descartes' work. This, besides being the longest of these papers, is undoubtedly the most important. It is also the most curious. Newton clearly intended to write an elaborate treatise on Hydrostatics; but, after completing a long criticism of Descartes, he seems to have lost interest in his original purpose. ... The trouble starts when Newton attempts to define the basic concepts, space, place, and body.

Hall is obviously troubled by this essay. In his introduction Hall shows far more concern for Newton's "metaphysical" discussions about God than for the scientific importance of the concept of space which Newton is presenting. He says the essay is immature.

Hall, Unpublished Scientific, pp. 75, 90.  
Ibid., p. 76.
The structural failure of the essay, which consists for the most part of an enormous digression leading very far from the announced subject of hydrostatics; the immaturity of some of the thought; the pomposity of a good deal of the Latin; the over-elaborate proofs of elementary theorems, all combine to support the same judgement. The mature Newton would never have found such obvious satisfaction in solemnly confuting Descartes by arguments which, if not exactly trivial, are certainly laboured. One might well guess that this was an essay written by a young student who had recently been introduced both to the science of hydrostatics and to Descartes' Principia Philosophiae, and who was fired with enthusiasm to show his powers to his master. 1

We agree with Hall that this is a "young" Newton; but we dare say that Newton never considered Descartes to be his "master," nor did his satisfaction in confuting Descartes ever diminish with age; in fact, Newton was never really satisfied that Descartes had been overthrown until his own Principia replaced the Principles of Descartes.

The most obvious fact about the essay is that as Newton attempted to describe the motion of bodies in a fluid — whether in water, mercury, or in the "aetherial fluid" of Descartes' vortices — he could not succeed in his science with the definition of motion put forward by Descartes, nor with the identity of Space, Body and Extension which Descartes had maintained. Newton instead adopted a dualism of Space and Body. The total aim of the essay is to replace the monism of Descartes' Space-Body identity with a Dualism of Space and Body. Is this only a rational distinction, as of the type put forward by Henry More, the Platonist? Plato of course maintained the distinction between the Receptacle on the one hand, and the world of "becoming" within the Receptacle on the other. But this was a rational distinction. Did Newton have any empirical grounds for his dualism? After showing how Descartes' identification of space and body breaks down Newton says,

1 Ibid., pp. 89-90.
But lest any doubt remain, it should be observed from what was said earlier that there are empty spaces in the natural world. For if the aether were a corporeal fluid entirely without vacuous pores, however subtle its parts are made by division, it would be as dense as any other fluid, and it would yield to the motion of bodies through it with no less sluggishness; ... Since the resistance of the aether is on the contrary so small when compared with the resistance of quicksilver as to be over ten or a hundred thousand times less, there is all the more reason for thinking that by far the largest part of the aetherial space is void, scattered between the aetherial particles. The same may also be conjectured from the various gravities of these fluids, for the descent of heavy bodies and the oscillations of pendulums show that these are in proportion to their densities, or as the quantities of matter contained in equal spaces. But this is not the place to go into this.  

This paragraph contains not only the empirical basis on which Newton developed his Space-Body dualism, but also contains the seeds which were to mature to the point of dismissing the Cartesian vortices simply because empirical evidence suggested they could not be there -- space was essentially empty.  

Newton speaks about the density of a fluid, about the void, about the descent of heavy bodies and oscillations of pendulums in proportion to their densities "or as the quantities of matter contained in equal spaces." What does all this mean? Newton is still trying to use the Aristotelian terminology, he speaks of the "intension" and "extension" of a body, the internal vs. external properties of a body. "Gravity" is an intensive property of a body.  

So, lastly, the intension of gravity is proportional to the specific gravity of the body; its extension is proportional to the size of the heavy body, and absolutely speaking the quantity of gravity is the product of the specific gravity and mass of the gravitating body. And whoever fails to distinguish these clearly, necessarily falls into many errors concerning the mechanical sciences.  

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1Newton, "De Gravitatione," p. 37; page references will be to the Hall edition of this manuscript.

2Ibid., pp. 149-150.
Newton has here spoken of density, the quantity of matter contained in equal spaces, of gravity, which causes a body to have weight, of specific gravity (which is the comparison of a particular weight of a body to an equal volume of water, the unit volume of water taken to have a specific gravity of 1), of mass, and of the motion of pendulums. How are all these terms related? In physics it is important to distinguish between mass and weight. The weight of a body is due to the "force" of gravity (of the earth, for instance) acting on a body; this "force" varies inversely with the square of the distance of the body from the centre of the earth. Although the weight changes, we cannot suppose that the "quantity" of matter in a body changes as the weight changes; thus the concept of mass is derived. Mass is an "inertial" property of a body — when a body is placed in a sling, as in Descartes' Principles, and given centrifugal motion — a property which, according to Newton, is constant unless the body is physically divided.¹ Weight is proportional to mass, that is, if a body is doubled in weight, the distance from the centre of the earth remaining the same, it is also doubled in mass. Thus mass is a universal property of body, whereas weight is a property only in reference to another body acting on it. In the course of his experiments Newton found that different types of metals have different "densities" or "specific gravities." That is, if a cubic centimeter of water is compared with a cubic centimeter of lead, it is found that the lead weighs approximately eleven times as much as the equal volume of water. That is, the specific gravity of lead is eleven times that of water; the density is also eleven times as great, except that in physics density is in reference to the

¹Descartes, Prin. (Ou), II, 39, pp. 63-64.
mass of the body, not in reference to its weight. Thus we have here a refinement in definition. Weight and specific gravity are proportional to mass and density respectively, but the former are particular properties of a body, the latter are universal properties. And in Newton's Principia we find that the very opening words are set forth to make these distinctions.

Definition I:

The quantity of matter is the measure of the same, arising from its density and bulk conjointly. Thus air of a double density, in a double space, is quadruple in quantity; in a triple space, sextuple in quantity. The same thing is to be understood of snow, and fine dust or powders, that are condensed by compression or liquefaction, and of all bodies that are by any causes whatever differently condensed. I have no regard in this place to a medium, if any such there is, that freely pervades the interstices between the parts of bodies. It is this quantity that I mean hereafter everywhere under the name of body or mass. And the same is known by the weight of each body, for it is proportional to weight, as I have found by experiments on pendulums, very accurately made, which shall be shown hereafter.¹

Here Newton points out that mass and weight are proportional, but not identical, and that the determination of the property of mass has been made with the use of pendulums. His conclusions are empirically founded. The compression of gases is also mentioned; he is not sure whether the "medium" (aether) in space really exists, but his physics can be carried on independently of it. Matter is a quantity which arises from "its density and bulk conjointly." Or expressed in a formula

\[ d = \frac{m}{V} \]

where \( d \) represents the density of the body, \( m \) represents the total mass or quantity of matter, and \( V \) is the total "bulk" as Newton says, or volume.²

¹Newton, Principia, p. 1; cf. also p. 413, where Newton refers to the Unity of Aristotle and Descartes on the identity of extension, space and body.

Notice that in this equation "V" or volume is an independent variable. The concept of density is a product of the ratio between mass and volume. A gram of water and a gram of lead have the same mass, but a gram of water will occupy a volume approximately eleven times as great as that volume occupied by a gram of lead. If a material of a particular density is doubled in volume, however, its mass will be doubled. Both the mass and density of a body depend on the independent variable Volume. A physicist may ask the question, What is the meaning of this independent variable? Newton answers that volume is space. Volume can exist without body (mass), but body cannot exist without volume, and thus Newton arrives at the conclusion that the "physical" world is composed of two basic realities, Space (Volume) and Body (Mass), and that of these two, in order to exist, body needs space, but space does not necessarily need body. It is our opinion that this distinction is a valid one on the basis of the empirical conclusions which Newton drew concerning the concept of mass. Furthermore, when we consider the implications of Einstein's theory of relativity for this dualism, we find that although mass is no longer an absolute concept, nevertheless the concept of "density" is still employed by Einstein himself, and it would seem that the empirical foundation on which Newton built his Space-Body dualism still stands.

Why do we consider this so fundamentally important? Undoubtedly one of the most influential books concerning Newton's concepts of space up to the present has been E.A. Burtt's Metaphysical Foundations of Modern Physical Science. In order to make his case that Newton introduced a priori (metaphysical) concepts into his physics, Burtt must show that certain basic concepts in Newton's physics have no empirical foundation. What Burtt has
done does have some validity. Undoubtedly Newton drew conclusions which were not entirely supported by experiment. Burtt is willing to admit that "This a priorism, however, is not strongly pronounced in the case of mass." After discussion the concept of mass, and giving Newton credit for his insights, Burtt then happily moves on to the concepts of space and time; "When we come to Newton's remarks on space and time, however, he takes personal leave of his empiricism, and a position partly adopted from others, partly felt to be demanded by his mathematical method, and partly resting on a theological basis, is presented, and that in the main body of his chief work." What Burtt fails to see, or at least point out, is that if you are going to admit a concept of "mass" into your physics, which Burtt himself allows, then you are committed to that independent variable, Volume. And although Burtt even mentions the concept of density in relation to mass, he nowhere suggests that our empiricism has committed us to a concept of Space (Volume) which is implicitly independent of Body (Mass). Newton goes on to say that this space is Absolute, by which he means it is independent. Newton did have empirical evidence upon which to conclude that the Universe consists of a dualism

---178---

1 Burtt, Metaphysical, p. 238.

2 Ibid., p. 243.

3 Ibid., p. 239.

4 Newton's "Absolute" space will be discussed under his "epistemology," but it is well to anticipate in what sense Newton will use the term "absolute." Wilbur Long [Runees (ed.), Dictionary, p. 2], says, "Generically "an absolute" or "the absolute" (pl. "absolutes") means (a) the real (thing-in-itself) as opposed to appearance; (b) substance, the substantival, reals ... as opposed to relations; (c) the perfect, non-comparative, complete of its kind; (d) the primordial or uncaused; (e) the independent or autonomous." Newton's use of the term absolute to some extent suggests all of these notions.
between space and body; and although body appears to depend on space for its existence, we have no scientific evidence that space could not get along quite well even if all body were abstracted from it. This is what we mean when we speak of Newton's ontological understanding of space. Newton, like Plato, sees the Receptacle as essentially independent of its contents, and this conclusion was either arrived at, or supported by, Newton's empiricism. If Newton were to continue to follow Descartes and say: Space is Extended; Body is Extended; Space is Body, then the concept of mass, the fundamental concept in Newtonian physics, would be impossible. Newtonian physics is only possible if one maintains a dualism between Space (Volume) and Body (Mass), which can be seen in the form:

\[
\begin{align*}
\text{Space} & \quad : \\
\text{Volume} & \quad : \\
\text{Body} & \quad : \\
\text{Mass} & 
\end{align*}
\]

This dualism is the consequence of the equation relating density, mass and volume.

If it can be admitted that Newton does have an empirical basis for his dualism, what types of objections does he raise as a consequence against the Cartesian physics? His discussion does not follow any particular pattern, but the arguments relate generally 1) to the impossibility of the concept of motion in space in Cartesian terms; 2) to the concept of body which Newton must put forward to replace the Cartesian definition; 3) to the theological significance of the whole discussion. As a Christian Newton is aware that he is really discussing the problem of the nature of Creation, and consequently he cannot see the discussion as purely a question for the natural philosopher. It has ultimate consequences.

Newton's difficulty begins when he defines place as a part of space which
a body occupies. He is aware that this is not the standard Cartesian definition, so he must justify himself.

For the rest, when I suppose in these definitions that space is distinct from body, and when I determine that motion is with respect to the parts of that space, and not with respect to the position of neighbouring bodies, lest this should be taken as being gratuitously contrary to the Cartesians, I shall venture to dispose of his fictions.

And out of the thirty six page essay, Newton devotes thirty pages, approximately, to disposing of the Cartesian fictions. The major difficulty with Newton's concept of space comes at the point at which he tries to relate motion to the parts of space. If space is totally independent of body, how can we be aware of the motion of a body with respect to the immovable spatial background? This is a difficulty which Newton never did solve, and it is the most unsatisfactory aspect of his physics. He undoubtedly has empirical grounds for the dualism he establishes between space and body. But such a space is not going to be readily of value in experimental observation. What we need is some physical object firmly planted in immovable space, itself immovable. But Newton later defines body as that which is movable, and consequently, although he has good empirical grounds for believing that an absolute space exists, it really does not seem to be of much use to the physicist. This fact was a continual frustration to Newton. Furthermore, one can admit that if something like Newton's Absolute Space (Volume) does exist, then "true" motion is indeed in relation to that space; but how can the physicist relate motion to pure space? This has essentially become an


2 Ibid., p. 123.
epistemological question, and we will return to it in the next section.¹

What does Newton say this "space" is? He says we may think it is either a substance or an accident, but it is neither, it is "not absolute in itself, but is as it were an emanent effect of God, or a disposition of all being."² Descartes had said that if we take away body, "nothing" is left, but Newton does not find this the case. We can imagine extension without body.

And much less may it be said to be nothing, since it is rather something, than an accident, and approaches more nearly to the nature of substance. There is no idea of nothing, nor has nothing any properties, but we have an exceptionally clear idea of extension, abstracting the dispositions and properties of a body so that there remains only the uniform and unlimited stretching out of space in length, breadth and depth.³

Of what value is space? It is potentially capable of containing any geometrical space; it may be one, two or three dimensional.

And hence there are everywhere all kinds of figures, everywhere spheres, cubes, triangles, straight lines, everywhere circular, elliptical, parabolical and all other kinds of figures, and those of all shapes and sizes, even though they are not disclosed to sight.⁴

Thus that aspect of the universe which we call pure volume is for Newton the "physical" reality of the world of theoretical Euclidean geometry. How high is the correlation between the science of geometry and the reality of

¹Cf. Newton, Principia, p. 419; Newton suggests that "the centre of the system of the world is immovable," that is, the solar system. This is what is known as a "Galilean reference system;" see Cajori's notes to the Principia, n. 13, pp. 639-644.

²Newton, "De Gravitatione," p. 132.

³Ibid.; cf. Descartes, Prin. (Ou), II, 10, p. 45; G.J. Whitrow in his article "Why Physical Space Has Three Dimensions," The British Journal for the Philosophy of Science, Vol. 6, pp. 13-51, shows that in the light of the new geometry the three dimensional aspect of the universe is not necessary, but partly contingent. Nevertheless, as he shows, the "volumetric" character of space is a conclusion shared by Parmenides, Plato, Aristotle, Galileo, Descartes and Newton. Whitrow seems to attribute man's concern for the three dimensional to the fact that man himself, "the formulator of the problem," (p. 31), is three dimensional. The issues are geometric, physical and psychological.

⁴Newton, "De Gravitatione," p. 133.
space? Extremely high; Newton says, "Space extends infinitely in all directions."¹ How can an empiricist make this statement without himself travelling infinitely in space?

You may have in truth an instance of infinity; imagine any triangle whose base and one side are at rest and the other side so turns about the contiguous end of its base in the plane of the triangle that the triangle is by degrees opened at the vertex; and meanwhile take a mental note of the point where the two sides meet, if they are produced that far: it is obvious that all these points are found on the straight line along which the fixed side lies, and that they become perpetually more distant as the moving side turns further until the two sides become parallel and can no longer meet anywhere. Now I ask, what was the distance of the last point where the sides met? ... Nor can anyone say that this is infinite only in imagination, and not in fact; for if a triangle is actually drawn, its sides are always, in fact, directed towards some common point, where both would meet if produced, and therefore there is always such an actual point where the produced sides would meet, although it may be imagined to fall outside the limits of the physical universe. And so the line traced by all these points will be real, though it extends beyond all distance.²

This gives us an extremely important insight into Newton. 1) It shows that he is concerned to give an empirical demonstration of infinity. 2) It shows that he believes there is a one to one correlation between geometry and reality. This is underlined in his first letter to Richard Bentley in which Newton, in referring to the intelligent system of the universe, suggests that the system "argues that Cause [of the Universe] to be not blind and fortuitous, but very well skilled in Mechanics and Geometry."³ One almost suspects that mathematics is such an ultimate science that even God used it in creating the universe. This is of course one aspect of Newton's "a priorism" which Burtt attacks heavily. It was this that led Newton to believe that his mathematical equations (which we will discuss in relation to his epistemology)

¹Ibid.
²Ibid., p. 134.
³Newton, Opera, Vol. IV, p. 432.
were of an Absolute character. And if there is a one to one correlation between geometry and the action of bodies in the universe, then indeed the universe is a machine. Burtt is aware, however, that the "machine" analogy was firmly established by Descartes; Newton simply gave us a "truer" picture of the machine, although we never find Newton talking about trees and animals as machines, as we find with Descartes.  

Returning to Newton's "proof" that Space is infinite, he also finds compulsion for belief because "we cannot imagine any limit anywhere without at the same time imagining that there is space beyond it."  

This may not on the surface appear like proper empirical evidence, and yet an empiricist must pay attention to the imagination, for it is (as Locke argued) not something innate, but rather the product of experience and of psychological conditioning. What is there in man's experience which keeps him from imagining a limit to space? 

But at the same time, although we cannot imagine a limit to space, neither can we imagine space as infinite. But, Newton argues, we can understand it. 

We can imagine a greater extension, and then a greater one, but we understand that there exists a greater extension than any we can imagine. And here, incidentally, the faculty of understanding is clearly distinguished from imagination.  

Descartes argued that we cannot know space is infinite, therefore we will call it indefinite. "If Descartes now says that extension is not infinite but rather indefinite, he should be corrected by the grammarians. For the word
'indefinite' is never applied to that which actually is, but always relates to a future possibility signifying only something which is not yet determined and definite.\(^1\)

The cause of the infinity of space is the infinity of God. (Notice that it is not the other way around.)

Space is a disposition of being quæ being. No being exists or can exist which is not related to space in some way. God is everywhere, created minds are somewhere, and body is in the space that it occupies; and whatever is neither everywhere nor anywhere does not exist.\(^2\)

There can certainly be a case argued here that Newton is being a rationalist, and it is certainly true that he had to work himself free from his rational (classical) education. And yet, one cannot help noticing that in this argument Newton says that whatever does not exist in space does not exist. This is an extremely empirically grounded conclusion. Unless something -- including God -- has spatial existence, it has no existence. Newton maintains this position in the General Scholium to his *Principia*. Newton is very concerned to give God some form of empirical existence, and his concept of Space (Volume) serves that purpose. Newton continues,

Moreover, lest anyone should for this reason imagine God to be like a body, extended and made of divisible parts, it should be known that spaces themselves are not actually divisible, and furthermore, that any being has a manner proper to itself of being in spaces. For thus there is a very different relationship between space and body, and space and duration.\(^3\)

Newton is travelling on very rough ground here, and he knows it. Leibniz was later to accuse Newton of making God divisible, and this is why Leibniz had such confidence in his eternal indivisible monads (geometric points).

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\(^2\) *Newton, "De Gravitatione,"* p. 136.

But here Leibniz shows his rationalism, and Newton his empiricism. Although we may imagine the infinite divisibility of space, it is "not actually divisible."

Furthermore, by identifying the Infinity of Space and the Infinity of God, Newton is well on his way to pantheism, or as he says, people may think that Newton has made "God to be like a body." It is certainly significant that Leibniz, Spinoza and Newton all began their education with Descartes; the varied reactions of these men to Descartes is of the utmost significance. By making the universe into a machine, Descartes had really challenged the mind of each of these men to reintroduce God into the "machine." Leibniz tried to put life into the machine, and thus destroy the machine, with his monads. Spinoza identified God and the Machine, thus making the universe not quite so cold. The difficulty with both the Monadology of Leibniz, and the Pantheism of Spinoza, is that the Universe became totally independent. There was no longer a distinction between the Creator (God) and the Creature (Universe). If Newton did arrive at his dualism between Space (Volume) and Body (Mass) by an empirical method, he used this dualism to great advantage in maintaining a far more orthodox Christianity than that of Descartes or Leibniz. For it is in this dualism of Space and Body that Newton establishes the dualism of Creator and Creature, of God and of the Created Universe. God is independent of matter; space is independent of matter, although it contains it. And because Newton does maintain this distinction even though it is far from the traditional method of doing so, he is able to make a fairly consistent interpretation of "salvation" and all that it implies in the biblical sense. This will become apparent only in our next chapter, but we want simply to mention the importance of what Newton has done here, in contrast to his contemporaries,
and in anticipation of what Newton will do in his theological work. To identify the Infinity of Space with the Infinity of God, if it is not a rational or metaphysical conclusion, ought to have an empirical basis. Does Newton have such a basis? As a Protestant empiricist we should expect him to have some biblical basis for the identification. We shall see eventually that Newton does have some biblical basis for this identification; and if Newton does have an empirical base for this identification of the Infinity of Space and God, we shall actually have evidence to undermine what has traditionally been considered the "chief cornerstone" of his religious rationalism.

In reply to the objection that by making space infinite we have made something which will compete with God's perfection, Newton points out that "infinity is not perfection except when it is an attribute of perfect things."\(^1\) Infinite ignorance, wretchedness and the like are the height of imperfection.

What is the relation between space and time?

Lastly, space is eternal in duration and immutable in nature, and this because it is the eminant effect of an eternal and immutable being. If ever space had not existed, God at that time would have been nowhere; and hence he either created space later (in which he was not himself); or else, which is not less repugnant to reason, he created his own ubiquity. Next, although we can possibly imagine that there is nothing in space, yet we cannot think that space does not exist, just as we cannot think that there is no duration, even though it would be possible to suppose that nothing whatever endures.\(^2\)

Duration and space are alike in that they share the character of having "parts" which can be numbered. This of course makes both time and space very suitable variables which can be used in mathematical equations. The Cartesian geometry could employ space as an ordinate and time as the abissa, and thereby

\(^{1}\)Ibid., pp. 135-136.  
\(^{2}\)Ibid., pp. 137-138.
illustrate uniform linear motion. Space and time are also the usual variables in the calculus, providing the "motionless" background against which motion takes place.

Moreover the immobility of space will be best exemplified by duration. For just as the parts of duration derive their individuality from their order, so that (for example) if yesterday could change places with today and become the later of the two, it would lose its individuality and would no longer be yesterday, but today; so the parts of space derive their character from their positions, so that if any two could change their positions, they would change their character at the same time and each would be converted numerically into the other. The parts of duration and space are only understood to be the same as they really are because of their mutual order and position; nor do they have any hint of individuality apart from that order and position which consequently cannot be altered.

Leibniz considered space to be the "order of possible co-existences" and time to be the "order of possibilities which are inconsistent." This comes very close to Newton's understanding, except that as a consequence Leibniz considered space and time as "unreal," whereas Newton considered them to be the two permanent aspects of the universe; space and time, we shall see, are for Newton more real than body, they are substantial. Nevertheless the empirical evidence for the reality of space seems to be derived from the relation of density, mass and volume, although the existence of space and time results from the "disposition" of God's being.

On the basis of the distinction between Volume and Mass which Newton has developed, we are forced to examine briefly his concept of matter, in so far as it is related to space and time. 1) Newton's concept of mass led him to develop an atomic or particulate, mechanical, view of matter. We

---187--

1 Ibid., p. 136; cf. also Principia, p. 8.

2 Urmson, Western Philosophy, p. 211.
shall see evidence of this in "De Gravitatione," in the Principia and Optics, and also in a recently published Newtonian manuscript "De Aere et Aetheres."  

2) Newton at various times discussed an "aether," which might have filled empty space, and which might also have been something like the "Spirit of God." Here we shall mention Newton's letter on the "aether" to Robert Boyle, and his letter to Thomas Burnet concerning the Mosaic creation.  

The best work dealing with Newton's concept of matter has been done by Marie Boas (later to become Marie Boas Hall) and A. Rupert Hall. There has never been any doubt that Newton believed in at least a practical atomism, and what is also clear is that Newton's atomism developed as a result of his experimental method.

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In the Rules of Reasoning in his *Principia* Newton said:

We no other way know the extension of bodies than by our senses, nor do these reach it in all bodies; but because we perceive extension in all that are sensible, therefore we ascribe it universally to all others also. That abundance of bodies are hard, we learn by experience; and because the hardness of the whole arises from the hardness of the parts, we therefore justly infer the hardness of the undivided particles not only of the bodies we feel but of all others. ... Moreover, that the divided but contiguous particles of bodies may be separated from one another, is matter of observation; and, in the particles that remain undivided, our minds are able to distinguish yet lesser parts, as is mathematically demonstrated. But whether the parts so distinguished, and not yet divided, may by the powers of Nature, be actually divided and separated from one another, we cannot certainly determine. Yet, had we the proof of but one experiment that any undivided particle, in breaking a hard and solid body, suffered division, we might by virtue of this rule conclude that the undivided as well as the divided particles may be divided and actually separated to infinity.¹

This may indeed be called an empirical atomism. It is interesting to note that Newton does not here believe that mathematical demonstration of the divisibility of bodies necessarily proves their actual existence. This is not consistent with the one to one correlation which he supposes in "De Gravitatione" to prove the infinity of space by extending the sides of a triangle. The above discussion of "actual" division calls into question the "Absolute" and real or true status of his mathematical equations which will be discussed below.

Newton apparently arrived at his empirical atomism by two routes, by mathematics and by experimental science. Boas and Hall have pointed out that before Newton the mathematical atomists and the experimental atomists lived in separate camps.

¹ Newton, *Principia*, p. 399.
For while, on the one hand, the science of motion had become increasingly, in the hands of Galileo's successors — Roberval, Pascal, Wallis, Huygens — a branch of applied mathematics; on the other, the evolution of corpuscularian physics was the product of an essentially non-mathematical tradition — that of Gassendi, Descartes, Boyle, and Hooke. Thus, even though many of the mechanical philosophers were themselves notable mathematicians, there was no interpenetration of the notions of mathematics and natural philosophy in this case.1

Boas and Hall are certainly correct in saying that Descartes and Boyle belong to an essentially non-mathematical tradition; it can be slightly misleading, however, to see the names of Descartes and Boyle placed side by side in this manner. What perhaps should be said is that there were three prongs to the scientific effort before Newton: the mathematicians such as Wallis and Huygens who influenced Newton; the experimentalists such as Boyle and Hooke with whom Newton was closely associated; and Descartes, perhaps the first person seriously to attempt a universal synthesis of the new Weltanschauung. But the synthesis of Descartes was essentially rational; this is why he must rationally deny atomism on the one hand, while practising it in his cosmology on the other. Out of this background Newton arrives at an empirical atomism open to future falsification if "had we the proof of but one experiment." From his mathematics Newton knew "Unum est res omnis absolute." From his experimental work, especially in his study of Boyle, he know that atomism was practical. Even the rationalist Descartes found it useful.

The one motivation common to all was the attempt to elevate the scientific above the occult.2 And the particulate theory of matter which developed as

1 A. Rupert Hall and Marie Boas, "Newton's 'Mechanical Principles,'" p. 168.

2 Ibid., p. 168.
a result made dynamics the fundamental science. The difficulty was that the mechanical explanations offered by scientists before Newton were "nearly, if not quite, as occult as the forms and qualities they were designed to replace." Before Newton "the corpuscular philosophy permitted neither prediction, nor confirmation, being neither mathematical nor truly experimental." Here Hall and Boas have pointed to the eschatological or "predictive" function of the science Newton was to develop.

What was the key to the Newtonian success? His synthesis of mathematics and experiment. But his mathematical equations were formulated to serve as "laws" or predictive equations of natural phenomena; they became important when related to experiment. Consequently, we should look to the experimental side of Newton to understand the development of his understanding of matter as atomic, whose main property is mass. This seems to be confirmed in the study by Marie Boas, "The Establishment of a Mechanical Philosophy." She sees Robert Boyle's The Spring and Weight of the Air (1660), as the work having major influence during the seventeenth century in suggesting a particulate view of matter. There is no doubt that this work strongly influenced Newton. In Newton's notes at Cambridge, under the heading, "Speculations as to the constitution of matter," Newton has diagramed the particulate interaction of gas molecules in the fashion of Boyle. And the opening words of the Principia point to experiments on the density of air to illustrate the development of Newton's concept of mass.

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1 Ibid., p. 167.  
2 Ibid., p. 168.  
3 Ibid.  
Boas has pointed out that through Boyle Newton was interested in chemistry. A full understanding of Newton's chemical thinking and of the experimental basis of his conclusions will be reached only after a careful analysis of his extant chemical notebooks, now in the University Library, Cambridge. These have not been seriously studied since they were summarized by the group who compiled the Catalogue of the Portsmouth Collection in 1888.¹

Keynes thought that Newton's interest in chemistry was mystical, but Boas, who is more of a scientist than Keynes, says,

Even a cursory glance at Newton’s chemical papers indicates that his approach to chemical problems was not that of an alchemist. His explanations are in the language and spirit of experimental natural philosophy, quite different from the usually cloudy and often mystic views of the alchemists whose works he bought or borrowed so avidly, as he did all books that had any pretensions to dealing with chemical theory or practice. His library included scores of alchemical works; he read and was influenced by Van Helmont and his English follower George Starkey; but equally he read and was influenced by such natural philosophers as Robert Boyle who despised all mysticism in science. Actually Newton’s chemical approach was far nearer to Boyle’s than to Van Helmont’s. Many of Newton’s experiments on colors of chemical solutions appear to be extensions of Boyle’s experiments.²

Boas has independent support for this link between Boyle and Newton.

R.J. Forbes had made a general survey of Newton’s alchemy and said,

In conclusion we may say that Newton was an alchemist of the same sort as Boyle and many of his illustrious contemporaries, not intent on gold-making but seeking a theory of the structure of matter. The disconnected thoughts he left on this subject are correct, profound, and highly interesting. They show that he was an Adept in the highest sense of the word. It is high time that his chemical writings should be studied and published by specialists in this field.³

The over-all impression that we have begun to form at this point is that not only was Newton an experimental scientist, and that it was through his

² Ibid., p. 243.
chemical works that he empirically supported his particulate theory of matter, but that there was no really sharp division between the different fields of experimental endeavour which Newton undertook. We get the impression that the young boy who made the water clock and toys for his friends continued to construct "toys" in his personal laboratory which included a kiln at Trinity College. His knowledge of chemistry would be of some use in grinding the lens for the first reflecting telescope which Newton presented to the Royal Society, and thereby first drew attention to himself, a telescope to help him in his astronomical observations at the tower at Trinity. And as Boas said, his chemical interests supported his study of the diffusion of light in different colors in different chemicals. The refraction of light in different substances of different densities involved physical measurements. His experimental skill in chemistry undoubtedly helped him purify the different metals he would use in his pendulum experiments. And this combined with his study of the density-volume-mass relation of air led to his particulate or atomic view of matter, and the fundamental concept of matter as mass. And when Forbes and Boas suggest that in his chemistry Newton was strongly influenced by Boyle, and that his chemical work has not to this day been studied by specialists, it is for this reason that we conclude that no really definitive study has as yet been made of Newton's experimental method, and furthermore, from the preliminary conclusions of Boas and Forbes we believe we have a right to anticipate that a detailed study of Newton's experimental

---173---

1 Boas, "Newton's Chemical Papers," p. 244 ff.

2 L.T. More, Newton, pp. 6-20.

3 Ibid., pp. 59-74.
method would show that none had a greater influence on this method than Robert Boyle. Through Boyle's influence Newton arrived at a concept of matter as mass, not as extension, as with Descartes, and consequently Newton rejected the Cartesian monism of space-body-extension for the dualism of Space (Volume) and Body (Mass) implied in the work of Boyle.

Of course Boyle was not the only one to have experimented with air, although his publication led the way. In his article on "De Aere" Newton says,

In just the same remarkable manner (air) rarefies and is condensed according to the degree of pressure. The whole weight of the incumbent atmosphere by which the air here close to the Earth is compressed is known to philosophers from the Torricellian experiment, and Hooke proved by experiment that the double or treble weight compresses air into the half or third of its space.¹

"De Aere" actually represents the first chapter of Newton's treatment of the theory of matter; it is important that the second chapter is "De Aethere," for this shows that the aether was for Newton matter, although "more subtle" than air, shown by the experiments of Boyle.² Whatever this aether is, it gives little resistance to bodies. Newton says,

And that in a glass empty of air a pendulum preserves its oscillatory motion not much longer than in the open air, although that motion ought not to cease unless, when the air is exhausted, there remains in the glass something much more subtle which damps the motion of the bob.³

Newton's views concerning the aether have been very controversial. The aether is not capable of offering more than slight resistance to a pendulum, and certainly not capable of holding the planets in orbit as suggested by the

¹Newton, "De Aere," (Hall, ed.), p. 223.
²Ibid., p. 227.
³Ibid., pp. 227-228.
vortices of Descartes. In other words, the dualism of space and body must have contributed to Newton's eventual rejection of Cartesian vortices, and consequently, by the laws of physics which he accepted, he was forced to ask, What keeps the planets in orbit? This must be one of the underlying motivations for the *Principia*.

In his well known letter to Robert Boyle concerning the "aether" Newton says,

> The truth is my notions about things of this kind are so indigested yet I am not well satisfied myself in them, & what I am not satisfied in I can scarce esteem fit to be communicated to others, especially in natural Philosophy where there is no end of fancying.¹

It appears from Newton's comments that Boyle has urged him to send his thoughts or speculations in a letter. As so often with Newton, those aspects of his thought which are speculative would never have been written if it had not been for the encouragement of his friends. This is true of the *Principia*, of course, but also of his letters to Richard Bentley and his letter to Thomas Burnet, which are usually thought to represent the "true Newton," the metaphysician.

Concerning the "aether" Newton says,

> And first I suppose that there is diffused through all places an aethereal substance capable of contraction & dilation, strongly elastick, & in a word much like air in all respects, but far more subtile.²

What must be noted immediately is that the "aether" is capable of being contracted and dilated, it is a material substance much like air, but having less density than air. This "aether" serves a physical function, it is a


transporting medium for light, gravitational forces, and also it is a medium in chemical reactions. Newton never makes any suggestion of a relation between the "aether" and God, in this letter to Boyle, nor does Newton seem to suggest what Henry More had in mind by the "Spirit of Nature." The main advantage of the "aether" theory was it avoided the problems of the occult action-at-a-distance account of gravity, magnetism, etc. Hall has shown that Newton's "aether," unlike that of Descartes, had density as a property, and thus the space-body dualism is maintained. In another article, however, Newton completely rejects the "aether" as necessary for gravity, and returns to the concept of "vacuum."

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1 Robert A. Greene in his article "Henry More and Robert Boyle on the Spirit of Nature," Journal of the History of Ideas, Vol. 23, pp. 451-474, has traced out the dispute between Henry More and Robert Boyle; More tried to use Boyle's experiments in the Spring and Weight of the Air to support his idea of a "Spirit of Nature" as he developed it in his Immortality of the Soul; Newton had read both of these at Cambridge; Boyle, however, maintained that his science could succeed without such a "Spirit;" Greene said, "it becomes increasingly obvious that More's attribution of function to the Spirit of Nature is highly arbitrary, and that it is a catch-all for the inexplicable" (p. 461). The same might be said for Newton's "aether" as he here develops it.

2 Cf. Suppes, "Descartes and the Problem of Action at a Distance," pp. 146-152.

3 Hall, Unpublished Scientific Papers, p. 205.
I am not at all disturbed by that vulgar sophism by which inferences opposed to the concept of the vacuum are drawn from the nature of bodies as extension; since bodies are not so much extension as extended, and they are utterly distinguished from extension by their solidity, mobility, force of resistance and hardness. For all first or least bodies, from which other bodies are made, are hard.\(^1\)

Newton was torn between the concept of the aether and the vacuum. Both had advantages and disadvantages and we shall let the historians of science argue the case, although at present we accept the conclusions of the Halls. The "aether," if it did exist, was physical, had a property of density, and could therefore be distinguished from space, or volume, for by definition volume cannot be more or less dense.

In Newton's letter to Thomas Burnet concerning the Mosaic creation, there are passages which refer to the "Spirit of God" which could make one conjecture that for Newton the Biblical concept of "Spirit" offered the "middle term" between God and creation, and that perhaps this "Spirit" was the "aether." In discussing the creation Newton says,

One may suppose that all ye Planets about our Sun were created together, there being in no history any mention of new ones appearing or old ones ceasing. That they all & ye sun too had at first one common Chaos. That this Chaos by ye spirit of God moving upon it became separated from ye rest & upon ye separation began to shine before it was formed into that compact & well defined body we now see it.\(^2\)

\(^1\) Isaac Newton, "Draft Addition to the Principia," ed. Hall, Unpublished Scientific Papers, p. 316; cf. also Optics, Onera, Vol. IV, Query 31, pp. 242 ff., where Newton talks about "attraction" without a "medium." But elsewhere in the Optics he does talk about a medium, Onera, Vol. IV, Queries 18-21, pp. 223-225; also Principia, p. 547. Cf. Lasswitz, Atomistik, Vol. 2, pp. 559 ff. on Newton's "Athertheorie," Newton's divided stand on the aether question has led A.J. Snow in his work Matter and Gravity in Newton's Physical Philosophy: A Study in the Natural Philosophy of Newton's Time (London: Oxford University Press, Humphrey Milford, 1926), to distinguish between a "mechanical explanation of gravity" (pp. 128 ff.), and "Newton's hypotheses of 'active principles,'" (pp. 137 ff.). A somewhat metaphysical-physical dualism in Newton's work has led Snow to suppose there is a type of "mysticism" in Newton's scientific thought.

Certain'y Newton could have seen this "Spirit" as the medium for physical activity. Newton goes on to conjecture.

Further one might suppose that after our Chaos was separated from ye rest, by the same principle wch promoted its separation (wch might be gravitation towards a center) it shrunk closer together & at length a great part of it condensing subsided . . . to compose this terraqueous globe.¹

In Newton's first comment it is "ye spirit of God" which caused the Chaos to be separated, and then Newton talks about the same principle which promoted separation "wch might be gravitation towards a center" which leaves us to consider whether Newton is here implying that "gravity" and the "spirit of God" have something in common. Here is a point in favor of the "mystic" view of Newton, and furthermore, the fact that Newton is indulging in this speculative activity is a point in favor of seeing Newton as a religious "rationalist."

But we must keep Newton's closing words to this letter in perspective, "I have not set down any thing I have well considered, or will undertake to defend."² Generally this type of speculation is not typical of Newton, and we agree with the view of the Halls concerning Newton and the "aether." The Halls conclude,

Without seeking to cramp Newton's thought into a Procrustean bed of positivism, to which indeed his theory of matter is ill adapted, it seems unnecessary to run to the opposite extreme and (with Lord Keynes) make Newton a magus whose scientific thinking was at the mercy of inexplicable whims and medieval fancies. Nor can we agree with I.B. Cohen, who has suggested that, although 'Newton presented his thoughts on the aether with some degree of tentativeness' (an understatement indeed!) 'he did so over so long a period of time that the conclusion is inescapable that a belief in an aetherial medium, penetrating all bodies and filling empty space, was the central pillar of his system of nature.' For, since Newton always presented his aetherial hypotheses tentatively, even at the height of his scientific prestige, there is no reason to suppose that he regarded them as other than tentative.³

¹Ibid.
²Ibid., p. 334.
Consequently, not only are there grave doubts about whether Newton ever fully accepted the aether theory, if and when he did accept it, the "aether" was matter, not space, and having a property of density is separate from space. We see that the Halls, with their knowledge of Newton's science, including his alchemy, cannot accept the Keynes analysis of Newton as a magus in any of his scientific work.

Having thus examined by necessity both the roots of Newton's experimental method as well as the consequences of this method which led to his atomic theory of matter, we can now raise the question, What was Newton's understanding of the ontological status of matter (atoms)? In Newton's "De Gravitatione," after thoroughly laying the foundation of the space-body dualism, he says,

Now that extension has been described, it remains to give an explanation of the nature of body. Of this, however, the explanation must be more uncertain, for it does not exist necessarily but by divine will, because it is hardly given to us to know the limits of the divine power, that is to say whether matter could be created in one way only, or whether there are several ways by which different beings similar to bodies could be produced.1

When Newton says that body, in contrast to space, does not exist necessarily, he does not mean so much of logical necessity, as in Anselm's or Descartes' ontological argument, but rather that space necessarily exists because, as Newton says, God by his infinite existence constitutes space. Body, however, seems to be the result of God's decision to "create" as it were ex nihlo. How does God exercise his creative power? By an act of divine will.

Since each man is conscious that he can move his body at will, and believes further that all men enjoy the same power of similarly moving their bodies by thought alone; the free power of moving bodies at will can by no means be denied to God, whose faculty of thought is infinitely greater and more swift. And by like argument it must be agreed that God, by the sole action of thinking and willing, can prevent a body from penetrating any space defined by certain limits.2

2Ibid., pp. 138-139.
What Newton's theory of matter as developed here amounts to is that God seems to add certain properties to space, such as impenetrability, mobility, shape, mass, and the like, and that we in turn call it matter.

In the same way if several spaces of this kind should be impervious to bodies and to each other, they would all sustain the vicissitudes of corpuscles and exhibit the same phenomena. And so if all this world were constituted of this kind of being, it would seem hardly any different.  

Newton finally defines body as "determined quantities of extension which omnipresent God endows with certain conditions." If body seems thus to have an extremely tenuous existence, this is precisely the impression Newton is trying to convey. Newton believed

That for the existence of these beings it is not necessary that we suppose some unintelligible substance to exist in which as subject there may be an inherent substantial form; extension and an act of divine will are enough. Extension takes the place of the substantial subject to which the form of the body is conserved by the divine will; and that product of the divine will is the form or formal reason of the body denoting every dimension of space in which the body is to be produced.

Newton admits that his concept of extension plays the role of the materia prima in the Aristotelian philosophy, except that it is not material; and the substantial forms are created and sustained through the divine will. And Newton's space (Volume) "has more reality than materia prima." Although Newton believes he is being almost Aristotelian here, we believe he is in fact Platonic, for the Receptacle can obviously exist independently of its contents. Still, Newton's space seems to play a more active role in the construction of matter than does the Receptacle of Plato, which as the "nurse" of all becoming is passive.

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1Ibid., p. 139  
2Ibid., p. 140  
3Ibid.  
4Ibid.  
5Ibid., p. 141  
6Koyré in his article "Newton and Descartes," says that Newton's idea of "creation of matter out of pure space invincibly reminds us of the manner in which, in the Timaeus, bodies are formed out of the chaos" (p. 93). Despite the fact that Newton in "De Gravitatione" is opposing Descartes, Koyre rightly notes that Newton's arguments are often a priori and "deeply Cartesian" (p. 87).
Newton lies somewhere between Plato and Aristotle at this point. Why does Newton deliberately give matter such a tenuous existence, almost of the type later suggested by Berkeley?

If we say with Descartes that extension is body, do we not manifestly offer a path to Atheism, both because extension is not created but has existed eternally, and because we have an absolute idea of it without any relationship to God, and so in some circumstances it would be possible for us to conceive of extension while imagining the non-existence of God?¹

Here we see that the dualism of Space and Body is also the dualism of Creator and Creature. And Newton believes that if this dualism is not maintained, the path is open to Atheism. We saw that Newton sought to overthrow the Cartesian philosophy because, in the words of his friend John Craig, "he [Newton] thought it was made on purpose to be the foundation of infidelity."² We have seen the development of another distinction in Newton, the distinction between Creator and Creation. There are several ontological distinctions which have developed which have much in common, and can be seen thus:

<table>
<thead>
<tr>
<th>Volume</th>
<th>Mass</th>
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<tbody>
<tr>
<td>Space</td>
<td>Body</td>
</tr>
<tr>
<td>Creator</td>
<td>Creation</td>
</tr>
<tr>
<td>God</td>
<td>Universe (Atoms)</td>
</tr>
</tbody>
</table>

We can see that since space or volume stands separate from mass or atoms on the basis of the density, mass, volume equation, it is therefore tempting to see Volume and God as having something in common. God and Space are "Independent" variables, they are ontologically superior to mass, or creation. As Hall suggests, the difficulty for Newton was to bridge the gap between God and Creation, and the

¹Newton, "De Gravitatione," pp. 142-143; on the creation of atoms see also Newton's Optics, Opera, Vol. IV, Query 31, pp. 260-261.

²Brewster, Newton, Vol. 2, pp. 315-316.
Leibniz-Clarke Correspondence was an attempt to deal with this problem. Clarke stood between Newton and Leibniz searching for a tertium quid, some sort of medium for Newton's forces. While Newton claimed not to understand the cause of gravity, yet he knew the cause was God. Hall says, "aethereal hypotheses offered no solid bridge. Forced to choose, Newton preferred God to Leibniz." What Hall does not mention is that Newton is attempting to live with God as he was understood biblically by Newton, whereas Leibniz was only attempting to relate the God of metaphysics to the universe. Newton and Leibniz did not share common assumptions about the place of philosophy in theology. Newton attempts to account for Creation in terms of Genesis, Leibniz in terms of "intelligible Monads." The difference between Newton and Leibniz could be the difference between an "empiricist" and a "rationalist." In theology Newton studied two books: the Bible and Nature.

2) Newton's Unified Ontology— the General Scholium to the Principia

Newton said nothing at all about God in the 1687 (first) edition of the Principia, and this caused criticism so that in the 1713 (second) edition the General Scholium was added. It is interesting that Newton believed his first edition complete without theological comments, and that this went against the temper of the times. We are of the opinion that if Newton had not been pressured by friends, that he would have come very close to treating science and religion as separate (empirical) disciplines. Of course we would expect him to say something about creation in his theology, but he would not necessarily have made

---202---
theological comments in his physics, except that Richard Bentley, Thomas Burnet, and others seemed to demand it.

In any case, the General Scholium contains a summary of the ontological aspects of time and space, and their relation to God and to Creation.

When he begins his theological statement, he presents a short traditional argument from design; we know God "only by his most wise and excellent contrivances of things, and final causes,"¹ although the Bible and History were apparently among the "contrivances". Newton repeated the argument from design in several places, and there is no doubt that he found it convincing.² This fact is part of his religious rationalism, not doubt, but we want to point out that Newton never uses the ontological argument, as did Descartes and Henry More and Samuel Clarke. Newton's religious "rationalism" usually has an object other than the mind itself. If he is a religious rationalist, he is a conservative rationalist, especially in light of his age.

But the major part of the General Scholium is not devoted to the argument from design, which runs to only about ten lines, but rather discusses God,

This Being governs all things, not as the soul of the world, but as Lord over all; and on account of his dominion he is wont to be called Lord God or Universal Ruler; . . . The Supreme God is a being eternal, infinite, absolutely perfect; but a being, however perfect, without dominion, cannot be said to be Lord God; for we say, my God, your God, the God of Israel, . . .³

1) The first thing we note is that we have moved immediately from the God of nature to the God of the Bible. In his discussion of God Newton offers a footnote which traces out the roots of the biblical concept of God.⁴

¹Newton, Principia, p. 546.
³Newton, Principia, p. 544. ⁴Ibid.
And Newton assumes that the God of the Bible is the God of Nature, and not the God of metaphysics!

2) The notion of ἀρχηγός is especially a concept which Newton could hardly have derived from nature! In fact, it is a notion which he has adopted from his favorite biblical book, the Apocalypse of John. The opening words of the Apostles’ Creed are "I believe in God the Father Almighty," and ἀρχηγός means "Almighty, All Powerful, Omnipotent (One)," and the word is used in one form no less than nine times in the book of Revelation, more times than in any other book of the New Testament. As we shall see, the Apostles' Creed was the central statement of Newton's faith, and in fact the General Scholium at this point is stating Newton's biblical Christian piety.

R.S. Westfall, in his attempt to show that Newton was a religious rationalist, and who suggests that for Newton natural religion comprehends the total of religion, completely ignores the fact that even when Newton talks about God in the Principia, he talks about the God of the Bible.

One other point to note in Newton's definition of God (Almighty), is that Newton is extremely careful to say that God is directly in charge of the universe. The God of Leibniz was hardly needed to keep the machine in operation— it survived well without its creator, but Newton was extremely careful to avoid this, and Alexandre Koyré, much to his credit, has shown that this was a key issue in the Leibniz-Clarke Correspondence. Newton and Clarke tried to allow for God's continual providence.

When we examine Newton's understanding of God's work in

---204---


4Alexander (ed.), Leibniz-Clarke; see for example Clarke's comments, p. 52. Cf. also Koyré, Closed World, pp. 263-272.
history, we shall see that the concept of Providence is again pivotal. The
God of Newton is not the God of philosophy, and if he is going to be called a
religious rationalist (which we do not believe he should be), then this fact
ought at least to be made clear.

After discussing the name of God, Newton moves in the General Scholium to
discuss the relation between God and Space and Time. God is

eternal and infinite, omnipotent and omniscient; that is, his duration
reaches from eternity to eternity; his presence from infinity; he governs
all things, and knows all things that are or can be done. He is not e¬
ternity and infinity, but eternal and infinite; he is not duration or space
but he endures and is present. He endures forever, and is everywhere
present; and by existing always and everywhere, he constitutes duration
and space. Since every particle of space is always, and every indivisible
moment of duration is everywhere, certainly the Maker and Lord of all
things cannot be never and nowhere. . . . God is . . . omnipresent not
virtually only, but also substantially; for virtue cannot subsist without
substance. In him* are all things contained and moved; yet neither
affects the other: God suffers nothing from the motion of bodies; bodies
find no resistance from the omnipresence of God.1

1) It should be noted that nowhere in this section does Newton say that
God's omnipresence constitutes Absolute Space; rather he says God's presence
constitutes infinite space, and his duration constitutes infinite duration.
Certainly it is a property of this space that it is absolute, but we believe that
most exegetes of Newton's concept of space, Burtt and all who follow him, have
not clearly pointed out that in the epistemological section of his Principia
(which we have yet to treat) Newton nowhere mentions God; and in the General
Scholium where he relates God and Space, he nowhere mentions Absolute Space
or Time; why is this? We believe that there is a basic difference between God's
Space and Absolute Space; God's Space is Infinite; Absolute Space is finite.
Both are Absolute, but one is finite, the other infinite. Furthermore, in
physics Absolute Space is usually one dimensional; Newton's Infinite Space, if

---205---

Newton, Principia, p. 545.
it can properly be said to have any dimensions at all, always has three dimensions, it is Volumetric Infinite Space.

2) There is implicit in this section an answer to Berkeley's charge that any concept of Absolute Space is open to the possibility of seeing something independent of God and competing with God for infinity or eternity. Newton defines space and duration as attributes of God; we may speak of God's infinite goodness, infinite mercy, infinite love, infinite holiness, but we never suppose that these in any way compete with God. Newton sees both space and duration as similar attributes which have a substantial, not simply a virtual existence.¹

3) In Newton's stress on the reality of space and time, in contrast to Leibniz for whom the only reality are his monads, Newton has found a way for God to exercise his Providence over creation—"certainly the Maker and Lord of all things cannot be never and nowhere"—what Newton is doing is making certain that God does not become an absentee God, a God who created the universe, and then abandoned it.

4) In our citation of Newton concerning the relation of God to Space, the following occurred, "In him* are all things contained and moved." We are of the opinion that too little attention has been paid to this asterisk, for it is at this point that Newton adds a footnote which points to his empirical support for the statements which he has put forth concerning the relation of God to Space, (and he does not refer to Henry More for support). First of all, Newton refers to the opinions of the Ancients, and among others he cites Pythagoras, Thales, and Anaxagoras, and we have discussed these in our first chapter.²

¹Ibid.
But Newton also gives biblical citations; he contends that St. Paul, St. John, Moses, David, Solomon, Job, and Jeremiah all held the belief that it is in God that "all things" are contained and moved. It is undoubtedly true that Newton does not give an exhaustive list to support his conclusions, but rather tries to give a citation representative of each of the biblical writers. Someone might ask, what right has Newton, who apparently thought that we should not introduce philosophical opinions into divine revelations, to suggest that the opinions of the Ancient Greeks and the Bible agree at this point? It is undoubtedly because Newton himself asked this question that his first biblical citation is that of the Apostle Paul in his famous sermon in the Areopagus in Athens, recorded in the book of Acts. According to Acts Paul had been debating with some of the Epicurean and Stoic philosophers, and he was "provoked" by the idols in the city; he began his speech by referring to God as the creator of the world "and everything in it, being Lord of heaven and earth, he does not live in shrines made by man . . . since he himself gives to all men life and breath and everything." And then in the passage cited by Newton, Paul says that God created the nations of the earth that they should seek God, in the hope that they might feel after him and find him. Yet he is not far from each one of us, for "In him we live and move and have our being"; as even some of your poets have said, "For we are indeed his offspring."

We believe that it is important to note the verse which follows this citation also, for Paul continues, "Being then God's offspring, we ought not to

---207---

3 Ibid., 17: 27, 28.
think that the Deity is like gold, or silver, or stone, a representation by the
art and imagination of man.\footnote{This passage in Acts has always caused a con-
siderable amount of controversy among theologians and biblical scholars, but
nevertheless Newton does have something like biblical evidence to suggest that
there is some unity in Ancient Greek and Hebrew thought in so far as both
understood God to be other than material, very close at hand, so close
that it can be said that all created things live and move and have their being
in God. Newton would say that this "in" (\(i\)) is not virtual only, but also
substantial.\footnote{But not only does this passage in Acts link the biblical concept of God
to a Greek, Pythagorean geometric concept of Space, but Newton also cites
passages from John 14:2 and 1 Kings 8:27. These passages have reference to the
relations among the Temple of Solomon, God, and the Universe. When we come to
Newton's theology, we shall see that he went to great pains to reconstruct
Solomon's Temple, and we shall see that Newton believed that the Temple was a
microscopic model of the Universe, and that God's presence fills this universe
as he filled the Temple. Here is the point at which Newton's scientific and
theological worlds come together--In the Temple of Solomon. Here is his justi-
ification, from a biblical point of view, for saying that Infinite Volumetric
Space is an attribute of God. So far as we know, no historians of science
\footnote{Ibid., 17:29.}

\footnote{It is possible to conjecture in the light of Newton's letter to Thomas
Burnet concerning the Mosaic creation [Correspondence, ed. Turnbull, Vol. IX,
especially pp. 331-334], and in the light of Newton's comments about the
relation between God and Infinite Volumetric Space, that Newton has trans-
formed the biblical notion of \(\text{\textit{Ni\text{\textit{M}}} 37\text{\textit{[Gen. 1:2 etc.]}\textit{}}}\) into his belief that God
constitutes Space. If Newton was aware that the idea of "Spirit" and "breath"
were nearly identical for the Hebrews, since he also knew that ordinary "air"
decreases in density as one moves into "outer space," he may have felt that the
Hebrew notion of "Spirit" was inadequate. God cannot become less "dense" as one
climbs a mountain. But the density of "Volumetric Space" is constant.\footnote{It is possible to conjecture in the light of Newton's letter to Thomas
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climbs a mountain. But the density of "Volumetric Space" is constant.\footnote{Ibid., 17:29.}}}}
despite their concern for Newton's understanding of God and space, have ever pointed to this intimate relation between Newton's scientific and biblical worldview. Although Newton tried to avoid saying God is the soul of the Universe, nevertheless his studies of ancient religions have led him to believe that God is infinite as the Volumetric Space of our Euclidean Universe is Infinite.

The eschatological consequences of this position, however, are that God is in a sense confined to our space. And we shall find that when Christ "ascends" into heaven, that he never escapes from our universe; he simply goes to another place. This we say simply by way of preparation for the material which will concern us in Chapter IV.

In discussing Newton's "ontological" understanding of time and space, we have found that the concept of space is dominant. But both time and space are attributes of God. Eternity and infinity are not totally different from time and space, eternity is simply infinite time. In Newton's "De Gravitatione" we saw that Newton's science and theology were mixed into a single argument, but by the time the first edition of the Principia was published, Newton seemed to have separated the scientific from the theological aspects of time and space. Newton rejected the Cartesian concept of the identity of space-body-extension, we believe, on the basis of his concept of mass which when combined with the concept of density led to a distinction between mass and volume. Body and space were thus separate. This empirical approach to the distinction between mass and volume has often been missed by men such as E.A. Burtt.

The distinction between Space and Body also made it possible to distinguish between Creator and Creation, and thus avoid pantheism (Spinoza), but by suggesting that God was "spatially" present to all of creation, Newton also avoided removing God from the Universe (Leibniz). God was present to carry out his activity.
Furthermore, although Newton found the argument from design convincing, we cannot go so far as to say that he simply developed an elaborate "natural theology," but rather we maintain that the biblical aspect of his "natural" theology, whether in his letter to Thomas Burnet, or in the General Scholium to the Principia, has too often in the past been ignored. Newton had no use for the ontological argument, and if he is a religious rationalist, he is a very conservative rationalist. He has little or no use for metaphysics, at least in the traditional sense, in either his science or his theology. What he does have is an "ontology." He has theological and scientific conclusions which he has drawn concerning the nature of the universe and these conclusions have an empirical reference.¹

D. The Epistemological Dualism Between Absolute and Relative

Newton's theory of knowledge and his scientific method are really two sides of the same coin, and we do not suggest that Newton's epistemology can be separated from his ontology.

We maintain that Newton's scientific method is empirical. And we have tried to show that his ontology had empirical roots, and that it took the form of a dualism of Creator and Creature, God and the

¹Our discussion of the "ontological" function of Newton's concept of space in his eschatology is developed below in Chapter IV, pp. 337 ff.
Universe, uncreated Space (Volume) and created Body (Mass).

If Newton saw his mathematical method as one of synthesis et analysis, the same must be said of his scientific method as a whole. As a scientist he worked back and forth between the "sense data" of nature, and the theory, formula, or law which might somehow synthesize, and serve to predict the course which phenomena would follow in nature.

These laws or formulas represent knowledge itself, but this knowledge is achieved only by an examination of nature, and only by testing these formulas against natural events can we verify or falsify the formulas. Newton came to call the world of knowledge the "Absolute" world, and the world of sense data the "Relative" world, but both worlds were necessary for Newton's scientific method.

On the surface it may appear that Newton is simply upholding the traditional mind-body dualism, which in a sense he is, except that for Newton knowledge is not primarily a priori, as we found with Descartes, but rather for Newton knowledge is achieved inductively and empirically. Newton used mathematics, not philosophy, as the form in which to express his knowledge, in sharp contrast to Descartes. And although Newton was aware that sense perception is not entirely reliable, it is nevertheless reliable enough so that we may test our knowledge by experiment and measurement.

The concepts of time and space were of course fundamental to Newton's physics. One of the primary tasks of the
physicist is to deal with the problem of motion; motion has both spatial and temporal aspects, as we have seen with Plato, Aristotle, and Descartes. The difficulty before us is that this problem of motion is so fundamental that it is right at this point that Newton's science found both its strength and its weakness. Newton's scientific method, his empiricism - his form of empiricism - is still practised by science. But a major change has come about since the time of Newton due to the fact that the "physical" universe is no longer thought to consist of "mass" and "space" alone, but rather the physical world is a combination of mass and energy, or as it is expressed in Einstein's formula, \( E = mc^2 \). Furthermore, it appears that the concepts of space and time have also changed with the advent of Relativity, and since space and time had such an ontological significance for both Newton's science and his theology, we cannot safely ignore the differences between Newton and Einstein, although for the sake of brevity we are tempted to do so.

We shall examine Newton's epistemology on the basis of his remarks in "De Gravitations" and in the *Principia*, and following this we will express the relation which seems to exist between the concept of space in Newton's epistemology and his ontology.

In "De Gravitations" Newton seems to allow that a dualism of mind and body is a valid epistemological metaphysics, as stated by Descartes, except that Newton does not believe that "mind" should be defined as that which is not extended, nor should space and body be identified.\(^1\) What Newton does is to establish another dualism, between space and body, and then he suggests that mind may in fact be extended, which leads him to

\(^1\) Newton, "De Gravitations," p.131.
develop an analogy between space and mind both of which share a similar relation to body, independent of it, but related to it. Newton is indeed much like Henry More at this point, although More is not mentioned. The idea that God "has created bodies in empty space out of nothing"\(^1\) is made intelligible by the space-body dualism. In Newton's words,

Nor is the distinction between mind and body in this philosophy intelligible, unless at the same time we say that mind has no extension at all, and so is not substantially present in any extension, that is, exists nowhere; which seems the same as denying the existence of mind, or at least renders its union with body totally unintelligible, not to say impossible. Moreover, if the distinction of substances between thinking and extended is legitimate and complete, God does not eminently contain extension within himself and therefore cannot create it; but God and extension will be two substances separately complete, absolute, and having the same significance. But on the contrary if extension is eminently contained in God, or the highest thinking being, certainly the idea of extension will be eminently contained within the idea of thinking, and hence the distinction between these ideas will not be so great . . . a body may think, and a thinking being extend.\(^2\)

Newton sees that to deny the mind extension makes it difficult to unite the mind with the brain, a problem Descartes never really solved. Newton says very little about this union, nor about the problem of sense perception.

But should anyone object that bodies not united to minds cannot directly arouse perceptions in minds, and that hence since there are bodies not united to minds, it follows that this power is not essential to them: it should be noticed that there is no question here of an actual union, but only of a faculty in bodies by which they are capable of a union through the forces of nature. From the fact that the parts of the brain, especially the more subtle ones to which the mind is united, are in a continual flux, new ones succeeding to those which fly away, it is manifest that that faculty is in all bodies.\(^3\)

\(^1\) Ibid., p.142.
\(^2\) Ibid., p.143.
\(^3\) Ibid., p.146.
This is really the main part of Newton's discussion, in any work we have seen, of his understanding of the relation between mind, body and brain. Hall finds it inadequate, which it is, but he also finds that it has possibilities which Newton did not explore. 1 Although such an exploration is a proper subject of empirical inquiry, Newton was satisfied simply to accept the "fact" that mind and body are united, rather than to investigate it as a scientist, and it is probably as well for science that Newton spent his energy in an area which at that time was more likely to bear fruit.

In a sense Newton's mind-body dualism turns into a dualism between mathematics and physics. In reference to the habit of abstracting in mathematics and geometry Newton says,

"Certainly it suits mathematicians to contemplate things in the light of such reasoning; but in physics things seem otherwise." 2

And Newton opens his treatise on "De Gravitatione" with these words:

It is proper to treat the science of gravity and of the equilibrium of fluid and solid bodies in fluids by two methods. To the extent that it appertains to the mathematical sciences, it is reasonable that I largely abstract it from physical considerations. However ... I shall not be reluctant to illustrate the propositions abundantly from experiments as well. 3

Because of the nature of his topic, Newton is faced with the problem of motion. He begins by offering four definitions, the last of which is

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1 Hall, Unpublished Scientific Papers, pp.82-85.
3 Ibid., p.121.
"Motion is change of place," but this definition depended on the first three, 1) "Place is a part of space which something fills evenly," 2) "Body is that which fills place," and 3) "Rest is remaining in the same place." In his *Principia* after Newton has defined mass and centripetal force, he is then prepared to define motion. His Scholium defines time, space, place and motion. In both of his works Newton is trying to lay a solid foundation upon which he may treat the problem of motion, and the main change between "De Gravitations" and the *Principia* seems to be that Newton has begun with a definition of time, and then space, before coming to place. In the *Principia* the order is changed; he does not begin with place. Newton observes that common people understand these concepts "under no other notions but from the relation they bear to sensible objects." Burtt criticizes Newton for this, saying that he is abandoning his empiricism, but we do not think that this is the case. For Burtt says that Newton's concept of mass has an empirical basis, while his concepts of space and time do not; this is not really a fair criticism. First of all, the concept of mass is really an abstraction, it is an operational definition. It is not a definition offered by the "common people." But mass is an abstraction arrived at by an empirical method, and Newton also sees his concepts of time and space as operational definitions, and he has been no less an empiricist in the process by which he arrived at these definitions, although he may have been more successful in the case of mass than in the case of space and time.

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Burtt later admits, however, Newton does have a right to define them, despite their non-sensuality.

Before his definitions in the Scholium, Newton clearly states his mind-body dualism. He says that in defining time, space, place, and motion it is necessary "to distinguish them into absolute and relative, true and apparent, mathematical and common."1 That which is "absolute, true, and mathematical" belongs to the area of knowledge, it belongs to the area of mathematical theory and law which predicts order in nature. But an experimental scientist uses the "relative, apparent and common" which he perceives by his senses to arrive inductively at his mathematical theories. Thus there will be a dialogue or tension between the Absolute and the Relative, the Mathematical and Experimental, in Newton's science. One can say that it is Newton's a priori assumption that this is the way science should operate, although he undoubtedly arrived at this "assumption" through practical experience as a scientist. We shall see as we examine his definitions how this dialogue between the Absolute and the Relative works itself out.

In his definition of time Newton says,

Absolute, true and mathematical time, of itself, and from its own nature, flows equably without relation to anything external, and by another name is called duration; relative, apparent, and common time, is some sensible and external (whether accurate or unequable) measure of duration by the means of motion, which is commonly used instead of true time; such as an hour, a day, a month, a year.2

Here we see Newton's epistemological dualism of mind and body, of Absolute and Relative. First of all, it appears that Newton may be saying nothing more than the fact that time and motion are different, that time or duration is independent of motion, although motion involves time, and can be used to measure time. Newton might go so far as to argue that

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1 Ibid.
2 Ibid.
if there is no such thing as Absolute time, then there is no such thing as time; there is only motion. But the fact that we use motion to measure time suggests that time is more than motion. A radical empiricist might argue that there is no such thing as time, but to do so makes physics impossible; even modern physics abstracts time from motion as a variable in its equations. But Newton is saying more than this, he is saying that real time or duration is mathematically absolutely true, it never varies, it "flows equably;" Bergson might say that we only know this because we possess memory. Newton does have a right to believe that time may in fact be absolute, but this belief must, under the circumstances, be personal, it has little value in physics, except that perhaps all physicists assume temporal order in nature. In modern physics the observation of an event, and the recording of its location "in time," involves calculation of the distance between the observer and the event, and allowance must be made for the velocity of light, and the relative velocity of the observer and the event to each other. Time only has reference to observation of events. The chief difficulty with Newton's absolute time is that if we cannot measure it by motion, how can we measure it, and if we cannot measure it, of what value is it to physics?

After his definition of time, Newton offers his definition of space:

Absolute space, in its own nature, without relation to anything external, remains always similar and immovable. Relative space is some movable dimension or measure of the absolute spaces; which our senses determine by its position to bodies; and which is commonly taken for immovable space; such is the dimension of a subterraneous, an aerial, or celestial space, determined by its position in respect of the earth. Absolute and relative space are the same in figure and magnitude; but they do not remain always numerically the same. For if the earth, for instance, moves a space of our air, which relatively and in respect of the earth remains always the same, will at one time be one part of the absolute space into which the air passes; at another time it will be another part of the same, and so, absolutely understood, it will be continually changed.
When Newton says that Absolute and Relative space do not always remain numerically the same, perhaps we might picture the motion of the earth as it might be represented on a Cartesian co-ordinate graph, in which the sheet of lined paper on which the graph is drawn represents Newton's absolute space, and if the abscissa is the spatial location \( X_1 \), and the ordinate the location of earth at time \( T_1 \), then the numerical value of the location of the earth at \( T_2 \) will be \( X_2 \), and will differ from the value of \( X_1 \). And this is perhaps why Newton sees space and time as endowed with both absolute and relative values. For this reason Newton would consider the whole of Book I of the *Principia* to be an absolute treatment of motion, a mathematical treatment. At any instant the "absolute" and "relative" position of a body have the same figure and magnitude and value, but if the body moves, the value of the absolute and relative motion may not be the same. Two trains travelling on parallel tracks in the same direction at almost the same speeds may appear to have only slight relative motion with reference to each other, but if their "absolute" motion is with reference to the earth, this is considerably different from the relative motion of the two trains to each other. This is the meaning of Newton's discussion of the motion of air around the earth.

Newton then moves on to a definition of place:

Place is a part of space which a body takes up, and is according to the space, either absolute or relative. I say, a part of space; not the situation, nor the external surface of the body. For the places of equal solids are always equal; but their surfaces, by reason of their dissimilar figures, are often unequal. Positions properly have no quantity, nor are they so much the places themselves, as the properties of places. The motion of the whole is the same with the sum of the motions of the parts; that is the translation of the whole, out of its place, is the same thing with the sum of the translations of the parts out of their places; and therefore the place of the whole is the same as the sum of the places of the parts, and for that reason, it is internal, and in the whole body.\(^1\)

\(^1\) *Ibid.*, pp.6-7.
Place (locus) seems to be defined as a particular volume, a particular "bulk" which a body occupies. If we understand Newton correctly as saying that "Space" is essentially volume, then when he says that "Place is a part of space which a body takes up," he means that place is a particular volume which is part of the whole universal volume. When he says the "places of equal solids are always equal," but "their surfaces, by reason of their dissimilar figures, are often unequal," Newton means that a cube and a sphere might be equal in volume, that is, equal in "place," but they would have different figures or shapes, and therefore their surface areas would not necessarily be equal. Since Newton defines place as the particular volume of a body, he differs considerably from Descartes, and he stresses the fact that place is "a part of space; not the situation, nor the external surface of the body." To define place as something different from situation has unusual consequences; Newton goes on to say that situations or positions "properly have no quantity, nor are they so much the places themselves, as the properties of places." This definition of place can be very confusing, and more than one commentator on Newton has become confused by it.\(^1\) Nette's English translation does not help at this point, for we read first that place is "not the situation" of bodies, and later we read "Positions properly have no quantity;" "situation" and "position" are nearly synonymous terms, but the Latin situs is the same in each case.\(^2\) By saying that a situation is derivative of the place of a body, Newton means that if the body did not exist, if it did not occupy a particular volume to begin with, it could not occupy a particular situation. Furthermore, the situation of a body may change, although its place (volume) remains the same, and therefore situation is derivative of place. Newton is logically consistent in his definition, but to speak of place in this sense

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1 Baker, English Space, p.25.
of the word is so unusual as to be conducive of considerable confusion. By means of this definition, however, Newton can then go on to say that "the place of the whole is the same as the sum of the places of parts, and for that reason, it is internal, and in the whole body" by which he means that the volume of the whole is equal to the sum of all the particular volumes of a body.1

If we are correct in saying that Newton has defined place as the volume of a body, we then must ask, Is Newton consistent in his usage and distinction between the terms "place" and "situation"? It does not appear that this is the case; in a scholium in Book I of the Principia Newton, in reference to motion, says,

But by the same argument it may be alleged that a body arriving at a certain place, and there stopping, has no ultimate velocity; because the velocity, before the body comes to the place, is not its ultimate velocity; when it has arrived, there is none. But the answer is easy; for by the ultimate velocity is meant that with which the body is moved, neither before it arrives at its last place and the motion ceases, nor after, but at the very instant it arrives.2

It certainly appears from this statement that in his mathematical treatment in the Principia Newton uses the word place to mean the situation of a body. We find statements such as the following, "If the velocity with

1 In reading the definitions in the Principia it should be kept in mind that in "De Gravitatione" Newton begins his first definition by saying "Place is a part of space which something fills evenly" (p.122). Here Newton is surprisingly close to Aristotle's starting point (cf. above, Chapt. I, pp.51 ff); Newton begins with a body, which occupies a place separate from the body. We even find Newton talking about the relation between space, bodies, and the notion of "boundary" ("De Gravitatione," p.133), which was so important to Aristotle. It was Newton's concept of mass that caused him to reject both Aristotle and Descartes. But it appears that Newton's concept of "place" is his starting point in his developing of the notion of space. "Place" in relation to body has both "Absolute" and "Relative" or "relational" characteristics.

which the body goes from its place P is such,¹ in which "P" refers to a
point located at a particular place in a geometrical diagram, and later
he describes a centripetal force which is "universely proportional to
the squares of the distances of places from the centre."² We have not
made a systematic study of Newton's use of the word "place" in the
Principia, but from what we have been able to determine, Newton uses the word
locus in the text of the Principia to mean the equivalent of situs, but
in the Scholium where he defines locus he distinguishes it from situs; in
the definition in the Scholium locus seems to mean a particular "volume."

Why has Newton offered this unusual definition of "place" and then
proceeded not to use it consistently in his text? The reason is that Newton
wants, as we shall see, to relate Absolute motion to Absolute space; by
defining "place" as a particular volume or part of space, when he proceeds
to say "Absolute motion is the translation of a body from one absolute place
into another" it appears that "place" provides the missing link between
absolute space and motion. But when Newton is actually carrying out his scientific
work he always thinks of locus as the situation of a body, not as its volume.

The problem at this point may be even more complicated than we have yet
shown. It is possible to see how Newton's concept of absolute place, and his
concept of situation might converge. As he says, a situation is derivative
of the fact that a particular volume exists somewhere in Absolute Space. If
we first remember that Absolute Space is the Volume within which matter exists,
and against which he will relate the motion of a body, when we read that
"Place is a part of space which a body takes up" we see that a body occupies

¹ Ibid., p.61.
² Ibid., p.65.
a particular volume somewhere in absolute space. The particular volume, Newton could argue, is just as absolute as the whole volume of absolute space. The "parts" of absolute space are just as immovable as the "whole" of absolute space. And each immovable part has a particular situation, a particular point on the Cartesian graph; situation is a property of volumetric space.

Other aspects of this definition may be of conjectural interest. "Place" is volume occupied by a body. Newton defines body in terms of mass. Mass has a property of density, and density is expressed by the ratio of mass to volume, or we could say on the basis of Newton's definition of place, density is the ratio of mass to place. In other words, it could well be argued that here in Newton's definition of place as the volume occupied by a body we have again the "empirical" foundation of Newton's concept of space as volume which we described above, and that although the volume (place) and mass of a body are intimately related, they are not, as with Descartes, identical.

If this is the case, what is the relation between absolute and relative place? The difficulty is in understanding the exact relation of body to place. If no body existed, would there be any such thing as a place? A body, by its existence, occupies a particular spatial volume, but this volume does not have to be constant; the density of a body can change, although the mass of the body remains the same, as with the expansion or compression of air. The "place" of the air changes, although its mass remains the same. The difficulty with Newton's definition is this: if place is the volume occupied by a body, how can it ever be absolute? Newton says place is absolute or relative "according to the space." Absolute space had been defined as immovable; and later Newton
says, "it may be that there is no body really at rest, to which the places
and motions of others may be referred."¹ It may be that "absolute place" is
simply a cubic centimeter of pure "volume" whether it is filled or empty of
a body, and "relative place" is our estimation of the volume of a "wooden
cube," to use Aristotle's illustration.² Of course, in Newton's geometrical
treatment of motion, he does treat bodies as if they were at rest, as if
they occupied an absolute place. But whether we can determine an absolute
place from the relative measure of a real body is highly suspect. It is
here that Newton's attempt to move from the relative to the absolute breaks
down. And it is here, in the relation between density, mass and volume
(place) that Newton sees the "link" definition between absolute space
and absolute motion, for absolute space is not a body, whereas motion
always involves body. It might well be argued that if one were to begin
with Newton's definition of place, he could then go on to define absolute
space, and absolute motion. We see this definition as the most important,
and perhaps as the least clear, of all four definitions which Newton
gives of time, space, place, and motion.

Why have we devoted such a lengthy treatment to the subject? Not
only because we believe it is central to Newton's thought, but because
we believe it to be the most neglected of the definitions. Burtt, who
is most anxious to find fault in Newton's definitions of time, space,
place and motion gives a complete citation in his work of Newton's four
definitions with the single exception of Newton's definition of place.

¹ Ibid., p.8.
² Cf. above, Chapt. I, p.54; Aristotle, Physica, 216b4-6.
There he quotes only the first sentence. In Burtt’s exposition we see almost no mention of Newton’s definition of place, and we are very suspicious that Burtt, like many others, neither understood the meaning of the definition, nor its function, to say anything of its strengths and weaknesses.

What does Newton say about motion itself?

Absolute motion is the translation of a body from one absolute place into another; and relative motion, the translation from one relative place into another. Thus a ship under sail, the relative place of a body is that part of a ship which the body possesses; or that part of the cavity which the body fills, and which therefore moves together with the ship; and relative rest is the continuance of the body in the same part of the ship, or of its cavity. But real, absolute rest, is the continuance of the body in the same part of that immovable space, in which the ship itself, its cavity, and all that it contains, is moved. Wherefore, if the earth is really at rest, the body, which relatively rests in the ship, will really and absolutely move with the same velocity which the ship has on the earth. But if the earth also moves, the true and absolute motion of the body will arise, partly from the true motion of the earth, in immovable space, partly from the relative motion of the ship on earth; and if the body moves also relatively in the ship, its true motion will arise, partly from the true motion of the earth, in immovable space, and partly from the relative motions as well of the ship on the earth, as of the body in the ship; and from these relative motions will arise the relative motion of the body on the earth.1

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1 Burtt, Metaphysical, p.244; Alexandre Koyré in his work, From the Closed World to the Infinite Universe, does in fact quote all of Newton’s definition of "place," but he requires only seven lines in his book to explain what Newton means by place. He says place is necessary for Newton because "motion is a process in which bodies change their places" (p.163), and unless we are mistaken, when Koyré speaks of bodies changing their "places" he means "positions," contrary to Newton’s definition. We do not believe Koyré sees the vital role of place as a "volumetric-place" in space which a body can occupy, and move "into" as Newton later says. Also see Baumann, Die Lehren von Raumb, Vol. I, 482-494.


2 Newton, Principia, p.7.
Motion is perhaps the most important concept in the field of physics, and therefore the importance of this definition is obvious. We are not going to give a systematic treatment of Newton's concept of motion, for this is in a sense beyond our field of interest. Furthermore, most of the discussions already performed by scholars have been done with considerable competence, and as Stephen Toulmin said, "One needs almost to apologize for adding to the literature on Newton." Nevertheless, we must say a few things about what Newton is doing here.

Newton was convinced that motion is more than "relative;" in his article on "De Gravitatione" when he attempts to discuss the motion of bodies in fluids, he finds he must reject the Cartesian definitions of space, body and motion, and the main reason why he must reject the Cartesian doctrine of extension is that it does not allow for anything more than a relative concept of motion. Therefore, Newton sets out by giving a severe criticism of the Cartesian definitions as found in the *Principles*, and Newton undermines the validity of the whole Cartesian program. He is particularly provoked by the attempt of Descartes to say that the planets do not "really" move, but are at rest in their vortices. Furthermore, Newton contends that if all motion is relative, that while the outside of a body, such as the crust of the earth might move relative to the fixed stars or planets, that the inner part of a body, because its relative position to the surface of the earth does not change, that therefore one could conclude that while the outside of a body moves, the inside does not move. Newton goes on to say, "And thus physical and absolute motion

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is to be defined from other considerations than translation, such translation being designated as merely external".1 In other words, Newton is contending that motion, real motion, is in reference to some absolute frame of reference. And this motion is not merely mathematical, it is also physical. Newton argues that motion, real motion, is in reference to some absolute frame of reference.

It seems repugnant to reason that bodies should change their relative distances and positions without physical motion; but Descartes says that the Earth and the other Planets and the fixed stars are properly speaking at rest, and nevertheless they change their relative positions.2

We have shown that in Newton's understanding of the relation between density, mass and volume Newton had empirical support for his dualism between body and space. In the above statement we see perhaps one of the best arguments for the belief that real motion is in fact in reference to some absolute frame of reference. If two bodies change their relative positions, if two bodies are at one time two miles apart, and later are one mile apart, Newton would say, surely some real motion has taken place, one or the other of these bodies or both have moved with respect to some absolute frame of reference. What is that frame of reference?

For if the Philosopher (Descartes) refers this translation not to the numerical corporeal particles of the vortices, but to the generic space (as he calls it) in which those vortices exist, at last we do agree, for he admits that motion ought to be referred to space in so far as it is distinguished from bodies.3

It is clear that very early in Newton's life he had come to the conclusion that the very foundation of Descartes' physics, his concept of motion, was built on sand. It does not take an acute mind to see that Descartes' definitions of motion are not consistent; Henry More, who was no physicist, heavily criticized Descartes' concepts of motion in support of his concept of the

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1Ibid., p. 128; cf. Descartes, Prin. (Ou), III, 28, pp. 90-91.
dualism of space and body. But Newton moved on from criticism to construct a physics which overthrew the Cartesian physics, a physics which became a landmark in the history of science.

To illustrate what is meant by the concept of absolute motion, Newton often refers to the motion of a ship. Descartes had used this illustration in his *Principles*. Newton used it in his "De Gravitatione," and again as we have seen in his *Principia*, where he speaks about the "place" of a ship or its "cavity;" the relation between "cavity" and "place" underlines our interpretation of place as a particular volume. The cavity of the ship may contain a person who is moving, a person who occupies a particular "volume" which may be changing its situation. Through an analysis of each particular motion, of the person to the ship, of the ship to the banks of the ocean, or to the fixed stars, and of the earth to absolute space, we arrive at the absolute, mathematical, true motion of the person. We define this motion in reference to an immovable frame of reference, to absolute space. How can we know when we have arrived at an absolute frame of reference?

In reference to time Newton says, "Absolute time, in astronomy,

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1 Cf. Koyré, *Closed World*, Chapter VI, "God and Space, Spirit and Matter: Henry More," pp. 125-154; Koyré stresses the parallels between the thought of Newton and More on the idea of space. What seems curious to us, however, is that in this early article by Newton on "De Gravitatione" Newton specifically mentions Descartes' *Principles* on many occasions, and yet he never refers to any of More's works. If Newton is borrowing from More, he has not told us so. Cf. Toulmin's criticism of Koyré, "Criticism... Newton on Absolute Space," p. 226.

2 Descartes, *Prin.* (Ou), II, 24, p. 53.


is distinguished from relative, by the equation or correction of the apparent time. For the natural days are truly unequal, though they are commonly considered as equal, and used for a measure of time."¹ In other words, Newton knows of no absolute motion which can be used as a frame of reference by which to measure absolute time; consequently we must make mathematical corrections in making measurements. Absolute time itself, or duration, however, exists independently of measurement, it really exists, whether we find a measure of it or not; it "flows equably."² But by correcting our measurements of motion we may approach the mathematical precision of absolute time.

Absolute motion is in reference to absolute time and absolute space; it is motion from one absolute "volumetric-place" into another. But space is invisible, and "because the parts of space cannot be seen, or distinguished from one another by our senses, therefore in their stead we use sensible measures of them. For from the positions and distances of things from any body considered as immovable, we define all places."³ And thus we actually use relative motion rather than absolute motions, but in natural philosophy, in a mathematical treatment, we try to go beyond simple relative motions. There may or may not be any fixed body to which motion and rest may be referred; perhaps one exists beyond the regions of the fixed stars.⁴ Newton says that "we may distinguish rest and motion,

¹Ibid., pp. 7-8.
²Ibid., p. 6.
³Ibid., p. 8.
⁴Ibid., pp. 8-9; but in Book III of the Principia Newton puts forward the hypothesis "That the centre of the system of the world is immovable" (p. 419), which meant the centre of the solar system, a centre deduced by an analysis of the motions of all the bodies in the solar system—the sun was not the exact centre. This hypothesis has been discussed by Alexandre Koyré in his article "Concept and Experience in Newton's Scientific Thought," Newtonian Studies, p. 39.
absolute and relative, one from the other by their properties, causes and effects. ¹ As we have seen in the case of the ship, this may include the analysis of relative motions. A body occupies a volume, and its motion is from volume to volume or place to place, but only one of these places or volumes is exactly the volume at any instant of immovable space, and that volume is part of absolute space.

Wherefore, entire and absolute motions can be no otherwise determined than by immovable places; and for that reason I did before refer those absolute motions to immovable places, but relative ones to movable places. Now no other places are immovable but those that, from infinity to infinity, do all retain the same given position one to another; and upon this account must ever remain unmoved; and do thereby constitute immovable space.²

How can we be certain that there is such a thing as absolute motion? Newton grounds his contention on two arguments concerning absolute acceleration. "The effects which distinguish absolute from relative motion are, the forces of receding from the axis of circular motion."³ One experimental proof of absolute motion is Newton's so called "bucket experiment," in which he attempts to show that in spinning a bucket eventually causes the water to recede from the walls of the bucket, an experiment exhibiting many of the principles of Descartes' sling. Newton claims that the relative motion of the water is in respect to the bucket, which changes gradually, first as the water in the spinning bucket does not spin at all when the bucket begins to spin, and only gradually accelerates to the velocity of the bucket. As the water forms a concave

²Ibid., p. 9.
³Ibid., p. 10.
surface, however, it exhibits its absolute motion. Again, Newton suggests that if two globes were tied together and spun on a chord around a common centre of gravity, the tension on the chord might yield the absolute forces and motions of the globes. "And thus we might find both the quantity and the determination of this circular motion, even in an immense vacuum, where there was nothing external or sensible with which the globes could be compared."  

Newton then proceeds to present his laws of motion, laws which have been derived from his experiments, especially his experiments with pendulums. His first law, his so called law of inertia, states that a body "continues in its state of rest, or of uniform motion" in a straight line unless acted upon by an outside force. His second law is that if a body is forced to change its state of rest or motion, the change is proportional to the applied force. And his third law is that "To every action there is always opposed an equal reaction," the law which is essentially the principle behind present day rocket and space exploration. These laws have not only been useful to physics in the past, but it also seems unlikely that modern physics could have been developed without the prior development of something very similar to the Newtonian physics. Burtt is perhaps justified in saying that there are many vague definitions in Newton's Principia, definitions which have

1 Ibid., pp. 10-11.  
2 Ibid., p. 12.  
3 Ibid., p. 13.  
4 Ibid.  
5 Ibid.
shaky empirical foundation, such as the concept of "force,"¹ and yet we can also agree with Toulmin who suggest that Newton's laws should not be judged in the light of their ultimate significance, but rather in terms of their undoubted usefulness in the field of physics, not only for two hundred years after Newton, but to an extent even today.² What should be noticed is that Newton, like Descartes, has three laws of nature or motion, but Newton's were empirically valid, and represent a considerable refinement over the Cartesian definitions, which Newton, with his experiments with pendulums, must have discovered did not stand up under empirical testing.³ And it was essentially on the foundation of his concept of mass, derived from his pendulums, of his concept of motion as essentially linear, as with the sling of Descartes, his concept of gravitation as a universal "property" in a mathematical sense of mass, and proportional to it, with his dualism of Absolute and Relative time, space, place, and motion, and his empirically founded laws of motion, he proceeded to develop his Principia, which consisted mainly of two parts, Book I, or the mathematical treatment, and Book III, his "System of the World," in which Newton treats everything from the motion of the satellites of Jupiter to the experimental determination of the acceleration of bodies toward the earth, or the mathematical value of the "force" of gravity. Why is there this dualism of mathematical and experimental in the Principia? Because this is Newton's scientific method, it represents his epistemological concept, his theory of how

¹Toulmin, "Criticism ... Newton on Absolute Space," p. 7.
²Newton, Principia, pp. 1-6.
knowledge is achieved. When Newton distinguishes between absolute, mathematical, and true time, space, place, and motion, he is contrasting them with relative, apparent, and common time, space, place and motion. In other words, the dualism of Absolute and Relative we found in Newton’s definitions in the Scholium are a result of Newton’s scientific method; the dualism is a result of the way in which Newton acts as a scientist.

Why is Newton not satisfied simply to settle for "relative" motion?

In reference to the relative motion of Descartes he said,

And so, reasoning as in the question of Jupiter’s position a year ago, it is clear that if one follows Cartesian doctrine, not even God himself could define the past position of any moving body accurately and geometrically now that fresh state of things prevails, since in fact, due to the changed positions of the bodies, the place does not exist in nature any longer.¹

This statement more than any other we have found represents the motivating concept of absolute motion. Newton is saying that unless we can arrive at general laws of motion which can be treated mathematically, and be applied to the real world, we really have no science. Newton says we could not tell where Jupiter was a year ago. He could as easily have said, we could not predict where Jupiter will be a year from now. It is generally agreed that the function of mathematical equations in science is to predict natural phenomena, to predict their course. And the reason it is important to be able to make these mathematical predictions is that after we have arrived at a mathematical formula, it is then possible to test the formula. Suppose that Newton “predicts” that a year from now Jupiter will occupy a certain position; one year from now it will be

¹Newton, "De Gravitatione," p. 130.
possible for astronomers to observe Jupiter's position with a telescope, and empirically to verify or falsify Newton's equation which made the prediction. This is what science does; it observes phenomena; it then tries to synthesize a mathematical formula which will predict a certain pattern of events in nature; it then observes the pattern of events in nature, and tests the observed pattern against the predicted mathematical pattern.

Let us look back at Newton's ontology. We saw that through his experiments with pendulums he arrived at a concept of mass, which had as a property density, and as a consequence he formulated the following dualism:

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\begin{align*}
\text{Volume} & : \quad \text{Mass} \\
\text{Space} & : \quad \text{Body}
\end{align*}
\]

When we came to the scientific definitions in the *Principia*, however, in addition to this ontological dualism we have found an epistemological dualism, of Absolute and Relative, of Mathematical and Experimental; this is really also a dualism of "knowledge" and "observation" or we might say "mind" and "body," except that Newton's "physical" world consists of more than "body" or mass, it also consists of time, space, place and motion, body being necessary only for the existence of the last concept. Let us say this is a dualism of "mind" and "Universe," we might see the

\[\text{Cf. Newton's definition of "density," *Principia*, p. 414.}\]
relations in this way:

<table>
<thead>
<tr>
<th>Absolute Time</th>
<th>Relative Time</th>
</tr>
</thead>
<tbody>
<tr>
<td>Absolute Space</td>
<td>Relative Space</td>
</tr>
<tr>
<td>Absolute Place</td>
<td>Relative Place</td>
</tr>
<tr>
<td>Absolute Motion</td>
<td>Relative Motion</td>
</tr>
<tr>
<td>Mathematical Formula</td>
<td>Experimental Evidence</td>
</tr>
<tr>
<td>Mind</td>
<td>Universe</td>
</tr>
</tbody>
</table>

We have pointed out that the purpose of mathematics in Newton's physics was to predict a natural event, and we might see the "eschatological" or "predictive" aspect of Newton's science in this...

---

It seems something of a paradox that Koyré in his Closed World on the one hand seems to make Newton out to be a metaphysician, and on the other hand in his article "Concept and Experience in Newton's Scientific Thought," by the very title suggests the distinction between "Absolute" and "Relative," between Theory and Experiment. Koyré says that the chief difference between Hooke, Boyle and Newton is that Newton "measures, whereas Boyle and Hooke do not" (p. 42), and neither did Descartes. In his article "Newton and Descartes" Koyré says that Newton's Principia is "more empirical and at the same time more mathematical than that of Descartes" (p. 95). Marjorie H. Nicolson in her work, Newton Demands The Fuse: Newton's *Optics* and the Eighteenth Century Poets (Princeton: Princeton University Press, 1946), suggests that one reason the poets reacted against Newton is that they could not reconcile the dualism of his world "out there" (experiment) with the mind "in here" (mathematical theory), (p. 164 ff.). Although Newton gives some general comments about the place of experiments in science in the "Rules of Reasoning" in his Principia (pp. 398-400), perhaps Newton's best expression of the inductive method, of the dialogue between theory and experiment, is found in his *Optics*. Newton says, "As in Mathematicks, so in Natural Philosophy, the investigation of difficult things by the method of analysis, ought ever to precede the method of composition. This analysis consists in making experiments and observations, and in drawing general conclusion from them by induction ... For hypotheses are not to be regarded in Experimental Philosophy" (Newton, *Optics*, *Opera*, Vol. IV, p. 263). By hypotheses Newton means a priori hypotheses; he of course maintains that the aim of science is to arrive at general laws, but the method of obtaining these laws must be inductive. This is our understanding of the meaning of Newton's scientific method—his "empiricism."
Mathematical Formula : Experimental Evidence
Prediction : Event

In other words, it is not inaccurate to say that Newton sees the function of scientific knowledge as "prophetic," and that the value of prediction is that in this way we can verify or falsify the knowledge which at the present time we possess. It is important that the empirical scientist needs the time process in order to test his equations; the rationalist, the pure rationalist, does not need time to test his knowledge, his mind serves as its own test. It is also important to the empirical scientist that the events in nature can be observed to follow a consistent pattern; only then can he construct his predictive tool and test it.

In this regard it is interesting to consider Newton's view of miracles:

For miracles are so called not because they are the works of God but because they happen seldom and for that reason create wonder. If they should happen constantly according to certain laws impressed upon the nature of things, they would be no longer wonders or miracles but might be considered in philosophy as part of the phenomena of nature [notwithstanding their being the effects of the laws impressed upon nature by the powers of God] notwithstanding that the cause of their causes might be unknown to us.1

A.R. and M.B. Hall see this manuscript as evidence that Newton corresponded with Clarke to help with the Leibniz-Clarke Correspondence,2 and L.T. More says, "Newton's explanation of natural miracles can hardly be considered orthodox."3 More furthermore thinks this statement is a sign of Newton's skepticism over the reality of miracles. If we remember Newton's ontological discussion of God as Lord, in the General

1L.T. More, Newton, p. 623; the material in brackets was crossed out in Newton's manuscript.
3L.T. More, Newton, p. 623, n. 32.
Scholium, we can hardly believe that Newton would see God as either incapable of suspending his own laws of nature, or necessarily hesitant to do so. It seems to us that this statement concerning miracles by Newton shows considerable insight. Newton does not deny that "miracles" occur, but he does not believe that the ultimate source of miracles differs from the source of the laws of nature; both are results of the will of God. What Newton does say is that if miracles occurred frequently, and with regularity, then a scientist would study them, and "predict" that the miracle would happen, (as with the appearance of a comet), and then the miracle would cease to be a miracle. It is precisely for this reason that scientific method in the study of history has to be different from scientific method in the study of nature; historical events occur only once. The historian must develop different types of formulae, different types of predictive tools from those of the natural philosopher. Whether or not Newton's view of miracle is orthodox, his view does not exclude the occurrence of "miracles," and his view does reveal insight into the nature of his scientific method. When a pattern is observed in nature, the scientist constructs a mathematical formula, and then tests it in nature. This is Newton's epistemological dualism, his scientific method, which he clearly stated in the title of the Principia:

- Mathematical Principles : Natural Philosophy
- Mathematical Formula : Empirical Verification

The elements which participate in both the formula and experiment are time, space, place, motion, and mass. We should also say that these may be absolute or relative, and we want to add this comment in regard to space. We believe that in Newton's physics his "absolute space" and his "relative space" were usually linear. In relativity theory, this is still the case, although three linear and one temporal unit is required to locate a point particle in space and time. In Newton's geometrical treatment in Book I, the spatial treatment, the absolute, mathematical treatment of space is on a two dimensional surface, but the "lines" are one dimensional. Norman Feather
in his book, Mass, Length and Time,¹ has shown that length is the basic spatial unit for the physicist. While physical space is considered to be "three dimensional" nevertheless the physicist works with one dimension at a time, he can usually only measure one dimension at a time. We believe this is important in understanding the "ontological status" of space in Newton's epistemological discussion of space.

We have discussed two aspects of Newton's concept of time and space—the "ontological" and "epistemological" aspects—which cannot be entirely separated, but we believe that an attempt should be made to maintain this distinction, and discussions up to the present time have not done so. Thus Alexandre Koyré in one chapter of his book discusses "Absolute Space, Absolute Time and Their Relations to God."² Of course Absolute Space and Time do have a relation to God, but Newton nowhere mentions God in the Scholium to the Principia which treats Absolute Time and Space. The relation between Space, Time and God is essentially an ontological relation, whereas in our opinion Newton's distinction between Absolute Mathematical Space and Time and Relative


² Koyré, Closed World, pp. 155-139; Baker in his work English Space, goes on to trace out the impact of what we call the "ontological" aspects of space and time as it moves to John Locke, Bishop Berkeley, and then to Samuel Clarke and a whole school of debate resulting from the Leibniz-Clarke Correspondence. Included in this debate are men such as Edmund Law, John Clarke, Joseph Clarke, and Isaac Watts, to name a few (cf. Baker, English Space, pp. 55-67). One might also suggest, which is not usually done, that there is something "mystical" about this notion of space. One aspect of Newton's thought which neither the "mystic-magician" theory nor the "rationalistic-metaphysician" theory of Newton has examined is Newton's understanding of the nature of language and its relation to reality. Newton in his science, history and theology used several languages, and was always confronted with the problem of symbolism. And Newton even prepared an article which has been published by Ralph W. Elliot, "Newton's 'Of an Universal Language,'" Modern Language Review, Vol. 52, pp. 1-13. If Lord Keynes better understood Newton's use of language and symbolism, perhaps Newton's work would appear less mystical.
Measured Space and Time is essentially an epistemological distinction. To obscure this distinction, as Burtt and Koyré do by discussing God and Absolute Space and Time, has as a consequence the obscuring of Newton’s scientific method—his distinction between theory and experiment. Newton discusses ontology in the General Scholium, and there he does not distinguish between Absolute and Relative. In the General Scholium when Newton is discussing space, he never uses the term “Absolute Space.” Newton said that God by existing always and everywhere “constitutes duration and space.” Newton had every opportunity to call this space absolute space, but he did not. Remember from “De Gravitatione” that this space could exist independently of any body, or any geometric shape. It is not even strictly “three dimensional” until a dimension is applied to it; but what we call “volume” is perhaps the best way of expressing this notion of space, and because God is infinite, it is almost infinite.

What about absolute space? Newton never mentions God in the discussion of absolute space in the Scholium. This space is immovable, but what about the absolute space which is occupied by an absolute place (a particular volume)? It is immovable, but it is not infinite. And we suggest that in most geometrical or mathematical equations absolute space is not infinite, certainly it is not always infinite. It may be true, mathematical, absolute, but it does not have to be infinite; it may be infinite. Furthermore, we believe that this absolute space is very often linear, rather than volumetric, as in the geometry of Book I of the Principia.

What about relative space? Since relative space is always in reference to bodies, and bodies are always finite, it would seem that relative space is always finite, never infinite. Relative space, like absolute space, may be linear or volumetric; it is sometimes volumetric.
All three forms of space which we have described have a certain degree of ontological reality, although both absolute and relative space serve primarily an epistemological function in scientific method. Ontologically they form a hierarchy, or one might say an "order of being" whose properties and relations might be expressed as follows:

Volumetric Space : Always Volumetric : Always Infinite
Absolute Space : Sometimes " : Sometimes "
Relative Space : Sometimes " : Never "

Although we say that both absolute and relative space are sometimes volumetric, they are usually linear, and perhaps it would not be inaccurate to say that even when they are three dimensional they are so in a linear sense, whereas this does not have to be true of God's space. The "moral" aspect of this spatial hierarchy might be expressed in this way:

Volumetric Space : Ultimate : God : Best
Absolute Space : Knowledge : Man : Better
Relative Space : Experience : Nature : Good

It should be stressed that these parallels should be seen as a possible interpretation of Newton's concept of space, and a similar treatment can be shown in reference to time, since both space and time are infinite and eternal. Mass, however, does not have an ultimate standing, it is not eternal, it is created. And since mass participates in both absolute and relative space, the latter are for this reason ontologically inferior to volumetric space. Neither are place and motion of an ultimate quality. We do not believe that our analysis of Newton's spatial "Trinity" is without foundation. In this way we find

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In the past our "formulas" have been presented so that the "colon" means "stands in relation to and is separate from." In the following three tables of "formulas," however, the "colon" might better be interpreted to mean "is on the same level as, and shares the property of." In other words, Volumetric Space is on the level of being Always Volumetric and Always Infinite, and these concepts are superior ontologically to those in the table which are below them. Those separated by the colon are not so much separate as similar notions.
that it is also interesting to see that both Plato and Newton seem to have something of an ontological trinity, but Plato's trinity was in the order Being (Knowledge), Space (Receptacle), and Becoming (Body). Plato and Newton might be seen in this way:

<table>
<thead>
<tr>
<th>Plato</th>
<th>Newton</th>
</tr>
</thead>
<tbody>
<tr>
<td>Being</td>
<td>Knowledge-Ultimate</td>
</tr>
<tr>
<td>Space</td>
<td>Volumetric Receptacle</td>
</tr>
<tr>
<td>Becoming</td>
<td>Body (Motion)</td>
</tr>
</tbody>
</table>

What Newton has done is parallel in many ways to Plato, but the divergences are important. Because Newton supposes that God constitutes infinite volumetric space, it receives a higher ontological status than Absolute Space, or Newton's mathematical world of knowledge, - Plato's world of Being. Furthermore, Plato maintained an absolute separation (θύρα σπανιότητος) between Being and Becoming, or between mind and body; Newton, however, is able to relate the two worlds by his empirical method, and this is the most important difference between Plato and Newton; this is why Newton is an empiricist and Plato a rationalist. Plato could not see how Becoming or the world of experience could help us gain true knowledge. Newton developed and used the experimental method to test his mathematical world of Being. Except that Newton's Volumetric Space is infinite, it has much in common with Plato's Receptacle, and while Plato was never sure what status to assign to the Receptacle, since we arrive at knowledge of it by a sort of "bastard" reasoning, Newton, from both his density, mass and volume relation, and from his Biblical view of God, believes that space, along with time, is the highest category of our reality.

Let us return to Newton's ontological dualism which we saw earlier:

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Volume : Mass
Space  : Body
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Body is that which is created, and space is an eternal attribute of God.

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1 One of the implications of Einstein's theory of relativity seems to be that "mathematical space" is now subordinate to relative space.
If we allow the concepts of Volumetric Space and Absolute Space to merge, it appears that God is entering into Newton's mathematical equations in Book I of the Principia, and Newton is then open to the charge of pantheism, which he is most anxious to avoid. Furthermore, in maintaining his spatial trinity Newton is able to say that a physicist is perfectly capable of studying the laws of nature without studying theology, which appears to be what Newton believed since he presented the 1687 edition of the Principia without any reference to God, and rather than change the basic text of the Scholium to the Principia, Newton added the General Scholium.

So long as Newton's work is studied, there will undoubtedly be debate over his concepts of time and space. Newton's Absolute and Relative space and time have both ontological and epistemological aspects, which makes these concepts even more difficult. Thus J.A. Gould argues that there may still be three types of space, and that what we have described as Newton's "Volumetric Space," (although Gould does not use this term), may still have an ontological reality.1 Margula Rabinowitz, however, criticized Gould by saying that Newton's Absolute space and time were mathematical constructs, (as we have said, they had an epistemological function), and Rabinowitz concludes, "ontology doesn't seem quite to fit in such a context."2 We agree with Rabinowitz that Newton's distinction between Absolute and Relative is primarily epistemological, but there is no doubt that each type of space and time which Newton developed had an ontological status.

Once one allows, however, that Newton's Absolute Space and Time are Mathematical, then the debate begins over the function of mathematics in Newton's

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physics, and this is the concern of Stephen Toulmin and Dudley Shapere.\footnote{Toulmin, "Criticism ... Newton on Absolute Space," pp. 1 ff.; argues that Newton's concepts derived out of his empiricism, although Shapere in his article "Mathematical Ideals and Metaphysical Concepts" suggests that Newton's science, like all science, is founded on a procedural principle which chooses standards of measurement so that "no systematic irregularities will occur in nature which are not explained in terms of current physical theory" (p. 379). In other words, Newton's Absolute values are corrections on Relative measured values. The Absolute value is the consequence of the application of a scientific procedural principle.} It may be that many of the conclusions drawn about Newton's work depend on the presuppositions of the scholar. "Rationalists" can find metaphysics in Newton's definitions of time, space, place and motion, and in his use of mathematics in physics; "empiricists" can concentrate on Newton's rejection of metaphysical hypotheses, and of his use of the inductive, experimental method. And empiricists have their own interpretation of the role of mathematics in Newton's physics, such as that suggested by Strong. In our opinion, although Newton undoubtedly owed much to Descartes, it is clear that he also rejected Descartes at crucial points. Newton did attempt to reject metaphysics; he tried to make nature his starting point. He used the experimental method. Certainly Descartes did not simply work from the a priori: certainly Newton was not a strict empiricist. But to go to the extremes of making Descartes out to be an experimental scientist while making Newton into a kind of "metaphysician in disguise" obscures a fundamental change in scientific method between Newton and Descartes. Those who are tempted to make Descartes into a scientist and Newton into a metaphysician should keep one question in mind: Was it pure "accident" or chance that the theory of vortices of Descartes failed, whereas the theory of gravitation of Newton succeeded in replacing the theory of Descartes?

What is also clear and fundamental is that Newton's basic discovery was the concept of mass, to which the "force" of gravity was proportional. And
Newton's concept of mass led, through the density, mass and volume equation, to a dualism between mass and volume. Newton's scientific method led directly to his rejection of the Cartesian monism of space-body-extension.

Newton is very much like Aristotle in that it appears, from his early work on "De Gravitatione," and the way in which his concept of "place" is the link or pivot between space and motion, that Newton began his study of space with a study of a particular body-mass, with a particular "volumetric-place," and this led to a notion of volume in general. Newton's concept of mass, however, led him to reject the space-body monism of both Aristotle and Descartes, and with the dualism of space and body which developed, Newton then went on to a position something like that of Plato in which the Receptacle (Volumetric Space) of the universe to quite an extent independent of its contents. Historians of science in the past have all but ignored Newton's concept of place; we maintain that if it should not in fact be the starting point in the study of Newton's concept of space and motion, then its "link" position should at least receive far more attention than it has in the past.

Historians of science have also ignored, to our knowledge, the key link in Newton's thought between the Temple of Solomon, and Newton's concept of God and Space. It is precisely at this point that Newton's scientific and biblical world view come together, and it is unwise to try to discuss Newton's theology apart from his biblical studies, as has generally been done in the past. Thus Alexandre Koyré tries to explore more fully Newton's understanding of space by discussing the Leibniz-Clarke Correspondence. Certainly many of the things Clarke said represent Newton's views, and yet the type of metaphysical speculation in which Clarke indulges goes far beyond Newton's more reserved speculations.

1Koyré, Closed World, Chapter XI, "The Work-Day God and the God of the Sabbath: Newton & Leibniz," pp. 235-272. Koyré supposes he is discussing the "views" of Newton in this chapter, although he is discussing the writings of Clarke. We do agree with Koyré that it was important to Newton to keep God actively at work in the Universe.
By turning to the Correspondence, Koyré makes Newton's own interests seem far more metaphysical than they are; if Koyré had turned to Newton's theology itself, he would have seen the link with Newton's biblical and historical interests. The most general criticism we have of the treatment of Newton's "theology" up to the present time is that Newton's theology has generally been ignored. When we turn to Newton's theology we shall see that he was a "Puritan," he believed that ancient opinions had a greater purity than modern ones. This will help explain why he thought it important that his concept of space was first used by the Presocratics. He even argued for the rejection of the "aether" on similar grounds. "And for rejecting such a medium, we have the authority of those the oldest and most celebrated philosophers of Greece and Phoenicia, who made a vacuum and atoms, and the gravity of atoms, the first principles of their philosophy."1 As we shall see, Newton's love of the ancients is closely associated with his religious Puritanism, and to our knowledge, this aspect of his science, which is linked with his historical and theological studies, has received little attention in the past.

There is one thing in particular which makes us suspicious of the work by E.A. Burtt. He supposes that he has put forward a scholarly work, and he has; and to do so he has performed two tasks, that of examination of evidence, and then

1 Newton, Optics, Opera, Vol. IV, p. 237; when we examine Newton's doctrine of the church in our next chapter we shall see that Newton holds a very strong what we call "Anglo-Puritan" view of history. Newton believed that the Christian faith began to decline with the advent of Constantine and Athanasius [325 A.D.]. In his popular version of his Principia, his "System of the World," (printed in the Cajori edition of the Principia), Newton began by saying that the heliocentric view of the universe was "the philosophy taught of old by Philolaus, Aristarchus of Samos, Plato in his riper years, and the whole sect of the Pythagoreans; and this was the judgment of Anaximander, more ancient still" (p. 549). But, Newton goes on to say, "The whim of solid orbs was of a later date, introduced by Eudoxus, Calippus, and Aristotle; when the ancient philosophy began to decline, and to give place to the new prevailing fictions of the Greeks" (pp. 549-550). Aristotle's physics had about the same consequences for the world as Adam eating the forbidden fruit—paradise was lost.
the formulation of a thesis, that is, his "metaphysical" argument. He supports
this thesis, he hopes to test it empirically, on the basis of the evidence from
modern science. And it is almost true to say that no scholarship in the past
two centuries has attempted to work in any other way. It is interesting to com-
pare the titles of Newton's and Burtt's work in the following way.

Mathematical Principles : Natural Philosophy
Metaphysical Foundations : Modern Physical Science
Knowledge : Experience

This seems to us to be the ultimate irony, that Burtt has used Newton's
scientific method to show that Newton was not true to Newton's scientific method.
The subject matter is slightly different, but if we have any understanding of
what empiricism is, we have to say that both Newton and Burtt are trying to be
empiricists, their method is empirical, not primarily rational or metaphysical.
Perhaps Burtt is arguing that Newton was a poor empiricist, which can be argued,
but we believe that the question should be asked as to whether or not Burtt's
empiricism is adequate: 1) can Burtt properly discuss Newton's "metaphysics"
without studying Newton's theology itself, as Burtt admits he has not done? 1
2) Has Burtt attempted to make the distinction between Newton's ontological
understanding of space and time (the General Scholium), in contrast to Newton's
epistemology (the Scholium)? 3) If we are correct in saying that Newton's
definition of "place" is the link between space and motion, is it not dangerous
for Burtt to ignore this link definition as he obviously does? We do not be-
lieve these questions can be lightly dismissed.

1 Burtt, Metaphysical, introduces his section on "Newton as Theologian"
by saying, "Newton's place in the religious unsettlement of his era would be
an interesting topic for studious application" (p. 282), and he goes on to
say that Newton's prophetic studies "but confirm these indications that he
[Newton] was a pious, believing Christian in all that the term then implied"
(p. 283). As we shall find, Newton's prophetic work demands more attention
than it has here received from Burtt.
We have ignored one work by Newton which is generally taken as the starting point of Newton's "religious rationalism," that is, his letters to Richard Bentley. R.S. Westfall takes these letters as "normative" in discussing Newton's theology, rather than starting with Newton's theology itself. As we have admitted, Newton accepted the argument from design as valid evidence of the existence of God, and this is essentially the significance of Newton's correspondence with Bentley, and Westfall has examined this work adequately. What is important, perhaps, is that Newton, like Descartes, is interested in evidence that God exists. But whereas Descartes looks within himself, Newton turns to the "external" world. Perry Miller commented that these letters are important because "they set the precedent for the entire Enlightenment." in these letters Newton tries to be helpful, yet the letters "are not prolix... the careful reader does not get the impression of an outgoing enthusiasm." Westfall, however, is sure of Newton's "enthusiasm." We are not so sure. At the end of his first letter Newton said, "There is yet another argument for a Deity, which I take to be a very strong one; but till the principles on which it is grounded are better received, I think it more advisable to let it sleep." Perry Miller commented, "Our curiosity is aroused, but never shall be satisfied, by the evasive ending of his first letter: Isaac Newton had still another argument to prove the existence of God," and Miller conjectures that perhaps...
Newton had in mind the realm of optics. In our opinion the other argument is to be found where one might expect to find it---in Newton's theological work. Newton believed that biblical prophecies were fulfilled in history thus proving the existence and providence of God. In a sense he applied his scientific concept of verification to his biblical and historical studies. But this will only become clear with an examination of Newton's theology itself. What we have found thus far, however, is that care should be taken about speaking of Newton either as a "mystic" or as a "rationalist," at least in the field of science.

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CHAPTER IV

THE INFLUENCE OF NEWTON'S SCIENCE ON HIS THEOLOGY

Introduction

We shall limit our scope in this chapter to three basic areas: A) we shall attempt to show that an analysis of Newton's theological work is far more complex than has been suggested up to the present time, and we shall try to give an outline of the basic issues, especially his doctrine of the church, which determined Newton's theological work; B) we shall show that a considerable case can be made for the view that Newton's theological work has many parallels with his scientific work in terms of what we call the "empirical" (scientific) method, particularly in regard to the function of prediction in verification, and that this parallel has been all but ignored by those who have sought to call Newton either a religious "mystic" or a religious "rationalist;" and C) we shall show how the concepts of space, time and eschatology functioned in Newton's theology, and we shall discuss the extent to which these concepts were compatible with his scientific world view. Even this limitation leaves more material to be considered than we would prefer if we expected to be thorough. Nevertheless, it seems axiomatic that the last two aspects of Newton cannot be understood unless we first discuss Newton's religious Sitz-im-Leben.

A) Newton's Doctrine of the Church - "First Principles" Derived from Scriptures

When we say that Newton's theology is more complex than has been shown up to the present time, we mean that no one has as yet made the effort which will be necessary in order to understand that aspect of Newton's personality which is generally considered to be outside scientific interest. The Unitarian H. McLachlan prefaced Newton's theological manuscripts with a chapter entitled
"Newton's Theology, Its Development and Character."¹ in McLachlan's eager attempt to make Newton into a Unitarian, McLachlan places Newton in the eighteenth century, when in fact Newton's roots are in the sixteenth and seventeenth centuries. While F. Manuel presents an excellent account of the academic background to Newton's historical work, he does not clearly enough show that his chronological work is theologically motivated, nor does Manuel show that Newton's political activities may be intimately linked with his religion. Brewster's biography gives almost no attention to the historical situation in which Newton wrote his theology, and while L.T. More, much to his credit, does point to the political situation in which Newton actively participated, he does not see how Newton's scientific character exerts itself in this political situation. Because Newton was a Protestant, he was anti-Romanist, and consequently was a strong supporter of the Whig party which was instrumental in the suppression of the Stuarts.² We suggest in fact that Newton fully appreciated the religious importance of securing a stable civil government following the Act of Toleration (1689, two years after the first edition of the Principia); Newton's university work had also been combined with political interest, and in 1705 he stood unsuccessfully as a Whig candidate for Parliament. One of the important tasks of the Whig government after the Act of Toleration was the recoinage of money, English currency having apparently fallen into a

¹McLachlan, Newton, pp. 9-29.
dreadful state. Newton's work as warden and master of the Mint was most successful, although it was no easy task. Men such as DeVillamal have stressed the monetary gain which Newton received from this post, but it must be pointed out that Newton was personally and religiously interested in the success of the Whig government. More cites a document which Newton had prepared for circulation at Parliament which hints at the relationship for Newton of the political and the religious:

Whereas of late years some opinions have been propagated by superstitious men among the Christians of the Church of England which tend to incline those of the Church of England to break all communion and friendship with the Protestant Churches abroad and to return into the communion of the Church of Rome: such as are the opinions that the Church of Rome is a true Church without allowing her to be a false Church in any respect, and that the Protestant Churches abroad are false Churches and that they have no baptism and by consequence are no Christians, and that the Church of England is in danger, meaning by the succession of the House of Hanover.

Ibid. pp. 438-455; More observes that "William was absolutely dependent on the loyal support of the Whigs; without it, the repeated attempts to bring back the Stuarts might have succeeded" (p. 439). If the revision of the coinage had failed, the government would undoubtedly have fallen, and More concludes that "the more one studies the vital importance of the recoinage, the more one is convinced that it needed the united effort of four men such as Montague, Somers, Locke, and Newton." (p. 455). Nevertheless More censures Newton for not returning to his scientific studies as soon as recoinage was completed, and he says "we are driven to the conjecture that he never had been deeply interested in science for itself, and that he wished to have the opportunity to follow his stronger inclination towards theology and history." (p. 455). We would not say Newton was not "really" interested in science, but he undoubtedly found himself closer to the religious and historical destiny of England in his political work; Newton was a man of many interests.

DeVillamal, Newton, estimates that Newton, as Master of the Mint, had an annual income in excess of two thousand pounds (pp. 32-35).

As H. Hensley Henson has pointed out in his work *Studies in English Religion in the Seventeenth Century*, this century is undoubtedly the most complex period in the history of the Church of England. What is essentially true of the Church of England is that her history is one which lay between the forces of the Roman Catholic Church and of the Reformed Churches of the continent the latter of which usually are grouped together by Henson as Puritans. Thus the Church of England was basically Puritan in spirit or pieti but hierarchial in church polity, except for the brief period during which the Westminster Assembly attempted what Henson calls the "Presbyterian Experiment." Because of the way in which the Church of England had broken from Rome by the decree of Henry VIII, Church and State in England had always shared a temperament in spirit and practice. This had been true also for the Lutheran states which practiced the rule of *cujus regio ejus religio*. While the Calvinistic Reformation in Geneva had political as well as religious consequences, Calvinism in its polity reacted to the Republic of Geneva, and community interest became every man's duty. Furthermore, because the polity of the Reformed Churches was basically "democratic," this in itself embodied consequences for political theory. The idea of an Absolute Monarch and an Absolute Pope were to some extent both called into question by the Reformation, and the concept of separation of church and state eventually emerged among English Puritans. And the political revolutions for which men such as Newton's friend John Locke became the spokesman were to quite an extent the consequence of both the

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2 Henson, *Studies*, pp. 76-124.

Renaissance and Calvin's Reformation. To understand completely Newton's theology it would be necessary to examine the relationship between the theory of Church and State during Newton's time, to examine his theology in this light, to examine the influence of the Reformation on English thought, to examine the influence of the Reformed doctrine of the church on the Church of England, and thus on Newton, and to examine also the way in which a scientific mind would be likely to react to this situation. We cannot hope to carry out such an examination! We intend simply to point to the fact that Newton was aware of the currents of thought, and we are going to pay special attention to Newton's doctrine of the church. If we can point to one issue which stands above all others in value as a guide to understanding seventeenth century English religious thought in general, and Newton's thought in particular, it is an examination of the doctrine of the Church. When we raise the questions, What is the Church, What is its authority, What is its proper form of church government, What is its relationship to the civil government, What is the relationship of the Roman Catholic and Protestant Churches, and What is the chief difference between them, when we ask these and similar questions, then we shall begin to understand Newton's religious motivations, and we shall begin to understand the character of his theology. If all the evaluations of Newton's theology up to the present time share one weakness, it is precisely at this point of failing to try to comprehend the issues involved in answering the question, What is the Church? This is the issue which from the Reformation up to the present time has yet to be resolved, and it is the issue which confronted Newton no less than Luther, Calvin, Ignatius Loyola, Archbishop Laud and Richard Baxter. It is no exaggeration to say that one's whole theological stance will be influenced if not determined by a particular doctrine of the church. The only reason that McLachlan can appear to succeed in making Newton out to be a Unitarian is by
all but ignoring Newton's doctrine of the Church. If it can be admitted that Newton as an Arian appears to be in sympathy with the Unitarian doctrine of God, this is all that can be said for Newton's "Unitarianism", for we shall see that in principle and in fact Newton could no more have accepted the Unitarian doctrine of the Church than he could have accepted the Roman Catholic doctrine of the church. Newton always remained in communion with the Church of England, and we will soon show that he would undoubtedly have advised all "Unitarians" to follow his example.

1) Newton's Doctrine of the Church—Falkland and Mede

Newton said that "Religion is partly fundamental and immutable, partly circumstantial and mutable."¹ We have here in a different context Newton's "scientific" dualism between the Absolute and the Relative, the theoretical and the experimental (or experiential). Before we show how this principle was applied by Newton to his doctrine of the Church, however, we will examine some of the historical debates of which Newton was aware which led him to this position.

Newton's doctrine of the church essentially derives from John Calvin, although Newton interpreted Calvin in the light of the debates which had raged throughout seventeenth century England. It will perhaps be most helpful to point to two men among many who typify the various strands of current thought to which Newton paid attention. Much can be learned about Newton's doctrine of the church by studying a) the life and work of Lucius Cary, Lord Falkland, and b) the work of Joseph Mede, a Fellow of Christ College, Cambridge, both early seventeenth century figures.

a) Falkland—Roman Catholic "Infallibility" vs. Protestant Scripture

Lord Falkland is typical of the sensitive laymen in the Church of England who both as a scholar and as a member of a family of nobility eventually tried to come to grips with the problem of national church unity and church authority. Kurt Weber in his biography of Falkland points out that in his theological debates

he appealed, as Protestants were fond of doing, to the belief of Vincent of Lérins, who lived in the fifth century, that the Bible contains only truth and all things necessary to salvation...

Indeed, Falkland wondered why the Catholics bragged so much about an author who made so much against them.

Protestants, then, were self-satisfied in trusting the Bible as their guide. It was all the rule they walked by, yet a rule by the aid of which they could test and reject what the later Church had pronounced for authoritative and necessary tradition.¹

Falkland, according to Weber, was strongly influenced by such rationalists as his close friend William Chillingworth, which indeed he was.² But as Weber himself has pointed out, Falkland and most Protestants accepted the Bible as "a rule by the aid of which they could test and reject what the later Church had pronounced." This is an extremely important point to notice, for while rational humanism from the Renaissance undoubtedly influenced both Protestantism and Catholicism, we believe that the attempt to test church tradition by Scripture can represent one type of scientific-theological empiricism. Falkland did not simply ground his religious beliefs on reason, but rather on Scripture, although he, like all theological scientists, had to think about what he observed in Scripture.

²Ibid., pp. 157 ff.
The English Reformation in general used Calvin's Reformation as a model for reference for its own program. Since it was on political rather than theological grounds that it was begun, however, the English Reformation never allowed a radical criticism of church government of the type set forth by Calvin. As Henson has said,

To be a sound Anglican at the end of Elizabeth's reign did still mean to be patriotic and puritan in sentiment though not in name; by the accession of Charles I. patriotism was suspicious of, and Puritanism hostile to, the National Church.¹

The defeat of the Spanish Armada in 1588 is probably the key political and military victory of the sixteenth century; from this point the Protestant Church was assured that the Roman Catholic Church could never triumph by military force, unless, of course, the Anglican Church could be undermined from within. Internal struggle was the chief point of contention throughout the seventeenth century, which came to a climax with the complete overthrow of the Stuarts, and finally the Whig Parliament through the Act of Toleration in 1689 assured most Protestants of protection from persecution both from Rome and from each other.

Calvin's theology was seen by England as the main justification of the Protestant cause, and the success of England in 1588 increased the influence of Calvin and English Puritanism which found its chief royal spokesman in James I. His age produced the standard English translation of the Bible, certainly the epitome of the force of Puritanism, and as Henson points out, "When James I. died in 1525, Calvinism was still the prevailing belief of

¹Henson, Studies, p. 12.
religious Englishmen." But the English Church maintained the hierarchy as its form of polity with the exception of the brief period at which time the political situation in England required Scotland's assistance, and the Westminster Assembly was called in 1643 to work out a Presbyterian form of government for the Church of England, under the direction of the Long Parliament. The experiment failed both because the political situation changed, and because, as Henson suggests English sentiment was not open to Presbyterian discipline. Lord Falkland was a member of the Long Parliament which attempted the experiment, although Falkland supported the episcopacy. At this time there emerged two enduring elements within the Church of England: what might be called the Anglo-Catholics (Laud) and the Anglo-Puritans (Falkland).

The revolt was against the system established by the Anglican Archbishop William Laud who as a "high-churchman" sought to enforce episcopal uniformity to the exclusion of any form of Puritanism, extending his policy through the monarch. And as Henson comments,

"The brief triumph of Laudianism brought, as its first consequence, the violent overthrow of the constitution, political and ecclesiastical, and, as its abiding effect, the loss of the national character of the English Church."

Corruption in the court and general moral decay was the outstanding character of Laud's church, both among laity and clergy, together with an increasing papal character in Laud himself and it was against this that the English Puritan and patriotic sentiment revolted. Out of this situation came

1 Henson, Studies p. 12.
2 Ibid. pp. 76 ff.; Cf also Grimm, Reformation, pp. 562-564.
3 Ibid. p. 110.
4 Henson, Studies p. 33.
Lord Falkland's "Discourse on Infallibility," and it was this controversy which occupied the first dozen pages of Newton's "Common Place Book;" there were petitions, and speeches in Parliament concerning the state of the Church, and Lord Digby and Lord Falkland were among the level-headed men who spoke against the abuses of the church, but in favor of the episcopacy in general. Henson says of Falkland,

He deservedly bore the reputation of a just, unprejudiced, outspoken man of exceptionable gifts and learning. His speech has the ring of sincerity, and we may accept it as a faithful version of the opinion of the cultivated class on the situation.1

Falkland accuses the Laudians of working: "to try how much of papist might be brought in without popery; and to destroy as much as they could of the Gospel, without bringing themselves into danger of being destroyed by the Law."2 But Falkland was in favor of reforming men, not the church system.3

Lord Falkland was in the peculiar position of having been born to a mother who was eventually converted to Roman Catholicism, and who converted many of the younger children with her, but who did not succeed in converting Lucius Cary, not only because he was brought up by Calvinist grandparents, but also due to the strong influence on him of his studies at Trinity College, Dublin, beginning in 1622, where men such as William Temple and Archbishop Ussher had considerable influence. Tulloch said that Falkland, unlike his rationalist friend Chillingworth, "seems to have remained a Calvinist, and even strongly denounced Arminianism along with Popery in his first speeches in the Long Parliament. Nor is it impossible that he derived from this early time at Trinity, Dublin] the first impulse towards those latitudinarian views of

1 Henson, Studies p. 83.
2 Ibid. pp. 84-85.
3 Ibid. p. 86.
Church government for which he was afterwards distinguished.¹ Weber suggests that Lord Falkland was more of a Calvinist "than King James's church required him to be" and "in his later disallowance of the bishops' claim to a jus divinum he was most certainly not a Laudian."² Later in life, however, Falkland moved towards Arminianism.³ Through debates with his mother's priests, through his political involvement, and through his intellectual pursuits, Lord Falkland was eventually compelled to write his "Discourse of Infallibility."⁴

The difficulty with any principle of infallibility is well stated in his introduction to Falkland's discourse:

¹John Tulloch, Rational Theology and Christian Philosophy in England in the Seventeenth Century, (Vol. II; Edinburgh and London, William Blackwood and Sons, 1872), Vol. I, p. 82; cited by Weber, Falkland, p. 34. Tulloch sees Falkland as a pivotal figure of the seventeenth century, and he devotes his third chapter of Volume I to "Lord Falkland—A Moderate and Liberal Church," (pp. 76-169). Tulloch says, "His poems, his speeches concerning Episcopacy, and his Discourse on Infallibility survive, and bring before us as living an image of his mind and stamp of thought as we could desire" (p. 77). Newton like Falkland was latitudinarian, but Newton was less interested in current humanism, and more interested in ancient history than Falkland.

²Weber, Falkland, p. 35.

³Tbid., p. 193-94.

⁴Tbid., p. 223-25; In referring to Falkland's "Discourse" we will cite from the following work: Lucius Cary, late Lord Viscount of Falkland, A Discourse of Infallibility [of the Church of Rome], With Mr. Thomas White's Answer to it, and a Reply to him, ed. Thomas Triplet (2nd ed., London: Printed for William Nealand, 1660); Falkland's "Discourse" is 25 pages in length, but unnumbered in this edition; White's "Answer" includes pp. 1-49, and Falkland's "Reply" to White's "Answer" includes pp. 51-267. We cannot find this work in DeVillamé's "Catalogue" of Newton's library, but from Newton's notes in his "Common Place Book" it is clear that he either owned or had access to either the first or second edition of this work edited by Triplet, the first edition having been made in 1651; Cf. Weber, Falkland pp. 154-156.
How can the Roman Church convince a rational mind of its infallibility? It is useless for Catholics to argue in the usual circle of an appeal to Scripture and tradition, an appeal which derives its authority from the prestige of the Church, as being possessor of truth.¹

To say the church is infallible because the church says it is infallible, is an argument as circular as Descartes' method of doubt, leading to his cogito, ergo sum, and his distorted ontological argument for the existence of God. To a rationalism of the type of Descartes, the principle of infallibility might be "reasonable," but a Newton, a Protestant scientist, would require external evidence to prove the principle, not simply the tradition of the church. For Newton, it was precisely by the subtle delusion of this type of tradition that superstition was promoted. A person might accept the infallible principle on faith, much as Anselm presented his ontological argument as a confession of faith, but to use the infallibility argument as Descartes used the ontological argument was not scientific (although many found it convincing).

Lord Falkland did not approach the problem of infallibility from the point of view of "scientific method," however, but rather he attempted to show in fact that the Roman Church was not historically infallible. He argued from tradition itself to show that the Roman Church had accepted as part of tradition certain bodies of belief which were later rejected, or as Newton introduces his notes on the "Discourse" by saying, "This Author writing against ye Papists about their doctrin of infallibility, urges ye doctrine of

¹Weber, Falkland, pp. 226-227; this summary by Weber is based on the concluding pages of Falkland's "Discourse."
of ye millenaries as of most indisputable tradition & yet rejected by them.¹

The chief of the millennialists was Papias, although most Christians in the first two centuries believed in the "celebration of ye thousand years after ye resurrection,"² including Irenaeus, although the later church rejected this position as heretical. If millennialism was accepted as traditional for the first two centuries of the Church, and then rejected, how can we be sure that what is now accepted as infallible tradition will not later be rejected?

In place of the authority of "infallible" tradition Lord Falkland wishes to substitute the authority of Scripture interpreted by reason. Why does the Roman Church reject this? It is "because when differences arise about the interpretation, there is no way to end them."³

Falkland admits this is true, but he prefers to live in charitable disagreement with his fellow Christians, if need be, than to live with the perils of the principle of infallibility. We will not be able to settle all differences about interpretation of Scripture, Falkland says,

"yet this will be no Argument against him that beleevs, that to them who follow their reason in the interpretation of the Scripture and search for tradition, God will either give his Grace for assistance to find the Truth, or his pardon if they miss it; And then this supposed necessitie of an infallible Guide, (with the supposed damnation for want of it) fall together to the ground."⁴

¹Isaac Newton, "A Common Place Book of Sr. Is. Newton" (Cambridge University, King's College, Keynes MSS No. 2), p. 1. This is one of the manuscripts sold in 1936 by Sotheby and Co., and one section (VII) was headed "Theology," (pp. 64-74), in their sale catalogue, and we will hereafter refer to this as Sotheby, Catalogue, followed by the lot number and page. The "Common Place Book" is under lot No. 235, pp. 65-66. Excerpts from this have been printed in McLachlan's work, pp. 127-141, although Newton's notes on Lord Falkland are not included. When quoting from Newton's unpublished manuscripts we shall follow the spelling he uses without comment. It is not unusual for him to spell "doctrine" with and without the "e" in the same paragraph; he also uses the familiar forms of abbreviation of that period.

²Newton, "Common Place", p. 1.

³Weber, Falkland, p. 227; drawn from early pages of Falkland's "Discourse."

Newton takes note of the Jesuit's answer to Falkland, who maintains that heretical opinions which claimed tradition claimed a "secret" tradition, such as the Carpocratians and Gnostics. To this argument Newton notes "The Ld. Falkland's Reply,"

Of ye Carpocratians & Gnosticks I have spoke before, but sure for ye Chiliasts this is only said & not proved. Howsoever this undeniably appears yt either Papias & Irenaeus thought not this tradition to have come such a way as you speak of, or els they thought it no heretical way but such a one as was (at least reasonably) to be assented to."

Since some form of Chiliasm was accepted for "250 years after Christ at least" either "ye Chiliasts are hereticks or your Church not infallible" as argued from tradition. Newton notes that it is this same line of reasoning used by Cardinal Perron in "his book against King James" and was based on "ye doctrine of ye church" that the Christian religion rests upon the infallible tradition of the fathers. Dionysius Alexandrius used his authority to destroy the millennial concept, and Falkland suggests that it seems quite possible that Chiliasm was destroyed, not because it lacked the support of tradition, but because the forces against it had "better fortune."

But the main argument against the concept of infallible tradition for the Protestant must come from Scripture, and Newton then adds his own personal argument against infallibility, and in support of millennialism:

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Thus you see ye tradition of ye ChiliasTs is so notoriously plain
that in one of ye best books (& I think I may say ye very best,
for they never did nor ever will be able to answer it) agt ye
Papist's infallibility, it is urged & relied upon as the main
argument against their doctrine of tradition, & this by a person
who was not biassed by any kindness for ye doctrine, (for he
believed it not:) but was only moved by ye undeniable plainness
of its tradition beyond yt for any other doctrin whatsoever, the trad¬
ition for ye authentickness of ye Scriptures only excepted ... [This author was concerned with] ye extinquishing of it [true
document] in after ages (as he intimates) wch can be no objection to
them that consider how great & durable an Apostasy there was to
happen. See 2 Tim. 1.13 & 2.2 & 4.4 Dan 7.25.1

The second part of Lord Falkland's Reply to the Jesuit, of which Newton
takes notice, is of special interest. Falkland brings up the Arian con¬
troversy, and points out that the Athanasian position was not part of
church tradition, but one arrived at out of debate. Newton quotes the
following from Falkland:

Consider what 80 Bishops, & those orthodox, decreed against
Paulus Samosatenus, & if you make it consent with Athanasius
his creed, I shall believe yt you have discovered a way how
to reconcile both parts of a contradiction. This I say not as
intending by it to prove ye Arrian opinion to be true,... [but
if there had been] a common & constant verbal tradition, the
chief Christians would not through want of caution have contra¬
dicted it, neither could Constantine if it had been then as known
a part of ye Christian religion as Christ's resurreetion, have ever
so slightly esteemed ye question when it first arose.2

1Newton, "Common Place," p. 3; we are attributing this quotation
to Newton rather than Falkland; unlike any other part of his notes on
Falkland, Newton has preceded each line of this statement with quotation
marks, yet we cannot find this as a direct quotation in either Falkland's
"Discourse" or his "Reply." In the rest of his notes, however, Newton quotes
directly from Falkland without marginal quotations—in other words, Newton
seems to be using quotation marks to set off his own personal summary of
Falkland's argument. Newton, in fact, adds something of his own—a
suggestion that the destruction of chiliasm by the "Papist" was part of the
"great & durable Apostasy" which was "predicted" in II Tim. 1:13, 2:2 etc.
We shall see that the concept of the millennium and the Great Apostasy are
fundamental to Newton's concept of the interpretation of the history of the
Church. For the material most related to this summary by Newton see Falkland,
Discourse, his "Reply" pp. 164-170.

2Falkland, Discourse, Falkland's "Reply," pp. 78-79; cited by Newton in
"Common Place" p. 4.
Falkland goes on to say that neither Athanasius nor Arius claimed the support of tradition, but that both argued from Scripture. As to why the word homoousios was not kept out of the creed,

I answer that I believe (or else he is not constant to his own reason) that he meant only those words to be unwritten which were in Scripture neither themselves, nor equivalently, whereas he took of ἕνα τοῦ κόσμου to be in ye Scripture in ye latter sense.¹

It would be upon these grounds that Protestants would support the orthodox Trinitarian formula. And Falkland concludes,

All which reasons move me to think yt ye generality of Christians had not been always taught ye contrary to Arius's doctrine, but some one way, others ye other, most neither as having been only spoken of upon occasions, & therefore me thinks you had better say with ye Protestants yt ye truth was concluded (as Constantine said it should be) by arguments from Scripture...²

Other issues such as whether infants are to receive the Eucharist, whether rebaptism is to be permitted, whether election and reprobation are a matter of foresight, and the whole problem of pre-destination, all tend to undermine the Roman Catholic view of a monolithic infallible church.³

But these do not greatly interest Newton. The two great debates, over Millennialism and Trinitarianism, are the areas in which Newton spent his greatest research. And both are linked with the prevailing Protestant


²Falkland, Discourse, Falkland's "Reply," p. 82; cited by Newton in "Common Place" p. 5. Although Newton does not cite the passage, perhaps Falkland's best statement of the Protestant doctrine of church authority is "Christ is our unquestionable, and infallible Governor... and the Scripture the place where His will is contained" Discourse, Falkland's "Reply," p. 199. Falkland does not say, however, that the Scriptures, or our interpretation of them, are infallible.

doctrine of the Church, as opposed to the Roman Catholic view of an infallible traditional church, which saw the history of the church after the second and third centuries as a time of the "Great Apostasy," and as far as Newton was concerned, the triumph of Athanasius was part of this apostasy, [although he never quite expressed it thus], and he grounded his justification of the Protestant position on the apocalyptic, eschatological conviction of a corrupt church, "For the time is coming when people will not endure sound teaching."  

The reason that we have pointed to the intimate connection between Falkland's argument against Roman infallibility and the Arian controversy is that because of the Protestant doctrine of the church Falkland could show more sympathy towards Arius, although he did not accept his position. We believe there are excellent grounds for suggesting that Newton thought Protestants were perpetuating a Roman Catholic error in supporting Athenasius. This will be even more clearly shown later, but the importance at this point is to see that the Unitarian McLachlan is anxious to separate Newton's Arianism from his anti-Romanism, for he says "it is certain that his [Newton's] study of the doctrine [of the Trinity] was not made for the purpose simply of upholding Protestantism against Roman Catholicism."  

In spite of McLachlan's wishes, one cannot separate Newton's doctrine of the Church from his doctrine of God.

Following the notes in reference to Lord Falkland's discussion of "Infallibility" Newton adds in his "Common Place Book" notes on the same subject, "Out of the Ld George Dibbie's letter to Sr Kenelm Digby," "Out of Sr

1 I Tim. 4:3.  
2 McLachlan, Newton, p. 25.
Kenelm's Answer," and "Out of Ld Digbie's Reply."¹ This is a battle between the Anglican Lord George Digby and the Roman Catholic Sir Kenelm Digby, the latter of whom is known mainly for his scientific and medical work, and an acquaintance of Descartes, who was involved in Roman Catholic politico-religious intrigues against the English Puritans.²

Lord George Digby, like Lord Falkland, presented a major speech in the Long Parliament in which he defended the Episcopacy, although he was Puritan in spirit and sought to rid the church of Laudianism.³ The main feature of the correspondence which Newton copied in his notebook is that it is between an Anglo-Puritan and a Roman Catholic, but there are tremendous political undertones to this apparently theological debate. In Lord Falkland we saw signs of Newton's apocalyptic interest, the millennial problems, the relation between infallibility and the Reformation principle of the rule of Scripture, and the Apostasy in religion, which may have included the Arian controversy. One significant note added by Lord Digby is, as he says,

¹William Simpson (ed.), Letters Between the Ld George Digby and Sir Kenelm Digby Concerning Religion (London: Printed for Humphrey Mosley, 1651); the correspondence took place between 2 November 1638 and 29 March 1639. The notes are found in Newton's "Common Place" pp. 7-11. DeVillamil does not seem to have included this edition by Simpson in his "Catalogue" of Newton's library, but again it is apparent that Newton had access to the work, and found it important.

²John F. Fulton, Sir Kenelm Digby, (New York: Peter and Katherine Oliver, 1937), pays attention to Digby's relation to Descartes and William Harvey (p. 22, pp. 56-62). Digby as a Catholic conspired with Queen Henrietta Maria in the 1640's, and he was appointed ambassador to the Vatican, according to Fulton, "to obtain money for an army to march against the Puritans in England. Innocent X was evidently fascinated by Digby's proposal . . . " (p. 24). Fulton comments, "Just what he [Digby] achieved by his many political intrigues is not clear . . . " (p. 65), but his life is a good example of the politico-religious turmoil of seventeenth century England of which Newton was aware. Sir Kenelm was a man of reputation, and seems to have been an acquaintance of Falkland; see Tulloch, Rational Theology, pp. 96 ff.

³Henson, Studies, pp. 79-83.
Hardly shall you find Scripture alleged more frankly by ye Fathers, or ye Church tradition proclaimed more loudly in any point of faith yen by Justin & Turtullian in ye rigid censure of ye use of Images . . . and [in all ye Millionar] most confident authorising of their Judaic doctrin.1

Calvin was the leader of the Reformation who most consistently condemned the use of images in the church; as the Bible, both Old and New Testaments, was the rule of faith and practice, the Puritans moved away from the Greek influence on the church back toward the Jewish Old Testament traditions, and for this reason we find so much in Newton that makes him appear to come to be more Jewish than Christian; Lord Keynes called Newton "a Judaic monotheist of the school of Maimonides."2 We shall deal with this problem in greater detail at a later point, but we want to point out that the material considered by Lord Falkland and Lord Digby have much in common with the general thrust of Newton's own interests. There is a strong political as well as religious polemic involved in the issues which are presented; the issues are tradition as opposed to the Scripture as the yardstick of Christian belief; and the debate is carried on in light of the debates of the Church Fathers themselves; we find Digby, like Falkland, saying in reference to men such as Justin Martyr and Tertullian, "I can easilier accord these Doctors wth Arius than wth Athanasius or ye 318 fathers of ye Nicene Counsel."3 Protestants were interested in all the early controversies, and the point at which the Fathers contradicted each other, because this was a pragmatic way of undermining the

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1Simpson (ed.), Lord George to Sir Kenelm, p. 4; cited by Newton in "Common Place" p. 7; Lord George asks in reference to the two traditions concerning the use of images, "and yet I pray you resolve me which of them I shall pass, as derived from infallibilitie?" Newton's analogy between the Spirit of God (the Father) and Space led him to oppose strongly any Form of the use of images in religion.

2Keynes, "Newton," p. 30

Roman Catholic claim that the Church has always stood united on an infallible traditional truth.

Protestants like Newton saw the Bible as the external standard of truth by which the works and beliefs of the church were to be measured and tested. Lord Digby, in this work copied by Newton echoes this argument of sola Scriptura, based on the authority of the Fathers and of Scripture:

But because my opinion (that ye Scripture are ye only rule of faith) is little considerable with one of so far a better judgement; take in this point ye opinion of ye fathers wch you so much rely upon. To begin with Tertullian...1

Digby then goes on to cite passages from Tertullian, St. Basil, Athenasius, and finally 'St. Austin' which support the rule of Scripture. The citation concludes in reference to these with the statement:

He had need be a confident sophister that would undertake to evade these Authorities; but yet if they may not be admitted, let ye Scripture be heard from itself, 2 Tim 3:14, 15, 16, 17. Galat 1, 8, 9, 11, 12. Deut chap 4 & chap 12. 1 Cor 4, 6, 7 in whch last text [that you may learn in us not to think above wt is written, that no one of you be puffed up] ye Apostle makes ye Scripture a remedy for yt wch some of ye Papists object agt ye use of it, namely that it puffs up ye learned above those of weaker capacity.2

The above reference to Galatians is extremely important, for we shall see that this is crucial to what Newton calls the "Fundamentals" of the Christian faith.

In this section we are seeking to point out that a discussion of Newton's theology is more complex than has been admitted by most scholars up to the present time. Newton's roots were in the seventeenth century, he was an Anglo-Puritan, and like Falkland and Digby his theological work

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1 Simpson (ed.) Lord George's final letter to Sir Kenelm, pp. 102-103; cited by Newton in "Common Race" p. 11.

2 Ibid.
was both political and religious in its implications, his work was oriented toward a particular doctrine of the church which meant that he had to be aware of the great debates of the Patristic Church, and the period of the "Great Apostasy" of the Church. Newton believed the concept of infallibility was a rule written for the church by the church; it was a rational justification of its position, and it was congenial to Newton, the Protestant Empiricist, to attempt scientifically to undermine "infallibility."

b) Mede—"Fundamentals" and the Church in History

We have pointed to the politico-religious interests of Newton in the work of men such as Lord Falkland and Lord Digby. We now want to study the work of one man in particular, Joseph Mede, who perhaps more than any other person encouraged Newton's scholarship in the field of biblical apocalyptic, and especially his studies of the books of Daniel and the Apocalypse of John.

More than any other seventeenth century theologian, Joseph Mede is the person with whom Newton both as a man and as a theologian had the most in common. Mede had a strong Puritan sentiment with an equally devoted stance toward Episcopal polity. He was what we have called an "Anglo-Puritan," as opposed to an Anglican of the Laudian variety. Although Mede's biographer was somewhat eulogistic it seems certain that Mede, like Newton, was shy, and hesitant to publish his works. Of his Clavis & Commentationes Apocalyp'ticae we are told that this work "was extorted from him by the loving violence of some Friends; otherwise he would have deferred the publishing of it."\(^1\) The third

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\(^1\) Joseph Mede, The Works of the Pious and Profoundly-Learned Joseph Mede, including a General Preface (pages unnumbered) and a "Life of Mede," (pp. I-LXXVI), ed. John Worthington (Vol II; 2nd ed.; London: Printed by James Elesher, for Richard Royston, 1664), citation from General Preface. Although Newton's library included the 3rd edition of Mede's Works, we will be citing from the 2nd edition.
edition (1672) of Mede's works was in Newton's personal library, and as we shall see Mede set the pattern for Newton's prophetic studies. Insofar as it can be said of Newton, Newton was Mede's disciple. Mede too was interested in natural science (biology), history, and the church fathers: and Mede like Newton was a Cambridgian man, Mede entering as a student and later acting as a master of the Platonists Henry More and Ralph Cudworth at Christ College. Mede enjoyed a "place of quiet retirement from the noise and tumults of the world" although he had many friends. If Mede and Newton had been contemporaries, they would undoubtedly have been close friends: Mede showed only slight interest in rational philosophy, he kept religion and philosophy separate, he was a biblical and historical theologian.

We shall postpone our investigation of Mede's influence on Newton's prophetic work, for first there are certain elements in Mede's doctrine of the church of which we must take note. While Mede fully supported the doctrine

---269---

1 DeVillamil, Newton, p. 86.


4 Ibid., p. XXVII.

5 It is perhaps noteworthy that Tulloch does not apparently even mention Mede in his work Rational Theology: he was not a philosophical theologian. In his second volume, Tulloch devotes chapter V, to "Henry More—Christian Theosophy and Mysticism," and Tulloch notes that More abandoned his earlier Calvinistic up-bringing (Vol II, pp. 305 ff.). More turned to Plato, and poetry, both un-Newtonian! The fact that Joseph Mede was More's master at Christ College may explain More's interest in apocalyptic, which seems out of place in his otherwise rationalistic and philosophical theology. Whereas the majority of More's theology is devoted to Platonic-rationalism, and shows some interest in apocalyptic, by contrast Newton devoted no attention to any notable philosopher (as opposed to a natural scientist), and in theology his work is almost totally historicoprophetic. Tuveson in his Millennium describes Mede as "one of the greatest Biblical scholars the English Church has produced" (p. 76).
that Scripture was the authority for Reformed Christianity, he did not accept Calvin's Presbyterian polity. Mede's work includes a discourse on I Tim. 5:17 in which he rejects the Presbyterian exegesis of the passage by which the "Authors of this new device" have sought to make a distinction between lay-ruling elders and ordained-teaching elders.¹ Mede was very much troubled by the divisions within Protestantism, and he thought that the difference between Protestants

is not in Fundamentals, but that they both agree in so much as is necessary to Salvation; and therefore that their differing in other matters of lesser import should not so far prevail to the either causing or continuing any uncharitable Disunions, as their agreeing in other Points, such as are Fundamental and Necessary to Salvation, should oblige and persuade them to Charity and mutual Forbearance, and the owning each other as Brethren and Members of the same Body, whereof Christ is the Head.²

We shall see that this expresses Newton's sentiments precisely. Protestants should find unity in the fundamentals of the Christian faith, and also, in their common opposition to Rome, the grounds for the opposition which Mede demonstrates in his prophetic work and in his treatise on "The Apostasy of the Latter Times," an exposition of I Timothy 4:1 ff.³

It must be remembered that Mede preceded the Long Parliament, and therefore he does not figure directly in the political activity which belonged to the generation which preceded Newton. And yet it was Mede's biblical scholarship, and particularly his historico-prophetic work which had strong consequences for political thought because they involved a divine view of history, and as Tuveson has pointed out, this view of history was a consequence of the Protestant doctrine of the church.

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To begin with, the Protestant tradition of pure scriptural authority to the exclusion of tradition and merely "human" authority, led to increasingly searching studies of the sacred text. . . . These studies were instrumental in producing a general recognition that the book of Revelation implied a millennium to come in the future; even the great authority of St. Augustine could not get around this fact. . . . Mede was an exponent of the millennium. The propaganda of Anti-Christ actually gained in force from this interpretation and it is no accident that Mede was an important source for the crowd of millennial enthusiasts who later attempted to interpret the course of the Puritan Revolution in terms of the sacred Book, and to find in it programs for action.

The Protestant doctrine of church authority led almost directly from sola Scriptura to an apocalyptic interpretation of history, and in approaching Newton it is important to remember that there was for Newton an "existential" relation between religion and politics, and it should not surprise us that Newton the theologian should become Master of the Mint. There was no separation of church and state in Newton's understanding of England.

We have chosen Falkland and Mede as "representative" of the various forces behind Newton's theology, but they are by no means exhaustive. We are forced, through lack of space, to ignore Richard Hooker and Richard Baxter whose works were in Newton's library,2 and we have said nothing about the events between 1660 and 1689 leading to the Act of Toleration, and we have said little about Henry More, John Locke, Samuel Clarke, or Isaac Barrow, to name four acquaintances of Newton who as theologians are worthy of attention in their own right. But this only illustrates what we suggested at the beginning, that a study of Newton's theology is complex at the least. We do find in Falkland and Mede something of a common bond in regard to their doctrine of the church; they are Anglo-Puritans, Mede more than Falkland; both would reject on biblical and historical grounds the concept of the "infallibility"

1Tuveson, Millennium, pp. 75-77
2DeVillamil, Newton, pp. 66, 80.
of the Church of Rome, and would support the principle of *sola Scriptura*, and the Episcopal polity. As Tulloch has suggested, there are undercurrents of religious rationalism throughout seventeenth century England, but we believe that Newton, like Joseph Mede, stands basically outside the "rationalist" tradition.

2) Newton's Doctrine of the Church—Its Anglo-Puritanism

It is difficult to determine where one ought to begin with Newton’s doctrine of the church, but his opening statement in "A Short Scheme of the *true Religion*" is perhaps satisfactory. Newton begins by saying,

> Religion is partly fundamental and immutable, partly circumstantial and mutable. The first was the religion of Adam, Enoch, Noah, Abraham, Moses, Christ and all the saints, and consists of two parts, our duty towards God and our duty towards man, or piety and righteousness, which I will here call Godliness and Humanity.  

This statement by itself is difficult to understand, but a statement in another paper, "That Religion and polity, or the laws of God and the laws of man, are to be kept distinct. We are not to make the commandments of men a part of the laws of God," helps expose the dualism within Newton’s doctrine of the church.

It is clear that the laws of God are to be found in the Bible, and that some of God’s laws involve our ethical conduct, but not all ethical precepts are God-given. In his "Short Scheme" Newton goes on to say that "Godliness consists in the knowledge, love, and worship of God; Humanity, in the love, righteousness, and good offices towards men. .. The first is

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2 Ibid., "Seven Statements on Religion," p. 53.
enjoined in the first commandments of the Decalogue, and the second in the six last.\(^1\) The Ten Commandments are God given, and therefore apparently some of our religion toward humanity is fundamental. In his "Irenicum: Or Ecclesiastical Polity Tending to Peace," Newton suggests,

It is therefore the duty of bishops and presbyters to govern the people according to the laws of God and the laws of the king, and in their councils to punish offenders according to those laws, and to teach those who do not know the laws of God; but not to make new laws in the name of either God or the king.\(^2\)

This thesis is immediately followed by Thesis 8, "The Church is constituted, and her extent and bounds of communion are defined by the laws of God, and these laws are unchangeable."\(^3\) God, and his laws, are fundamental, unchangeable, immutable. We could very well say these laws are Absolute, but that man's activity or man's laws are Relative in matters of religion.

It seems to us that there is a very strong parallel here between Newton's absolute mathematical laws, his absolute time and space, by which God's creation operates, and the Absolute Laws [the laws of God] which constitute the church, the people of God. While it is clear that Newton saw a distinction between what is "fundamental" to religion, and what is secondary, he never states dogmatically which is to be placed in what category. He tries to help us by saying that "The laws of the king extend only to things that are left indifferent and undetermined by the laws of God,"\(^4\) such as order in worship.

\(^1\)Ibid., "Short Scheme," p. 43.

\(^2\)Ibid., "Ecclesiastical Polity," Thesis 7: p. 40, there are three articles in McLachlan's edition headed "Irenicum," only the third having the additional reference "Ecclesiastical Polity Tending Toward Peace," a title which suggests Newton's interest in a unified Protestant Church, a view he shared with Falkland and Mede, despite that fact that Newton stood in time far beyond the breaking point in the history of English religion. We shall refer to the other two articles as "Irenicum I," which includes nine positions, and "Irenicum II," which is an uninterrupted narrative.

\(^3\)Ibid., "Ecclesiastical Polity," p. 40.

\(^4\)Ibid.
and the maintenance of civil government. "All persons baptized are members of Christ's body called the Church, even those who are not yet admitted into the communion of the synagogue of any city."¹ And it is in preparation for baptism that we learn what are the "fundamentals" of the Christian faith:

The fundamentals or first principles of religion are the articles of communion taught from the beginning of the Gospel in catechising man in order to baptism and admission into communion: namely, that the catechumen is to repent and forsake covetousness, ambition, and all inordinate desires of the things of this world, the flesh, and false gods called the devil, and to be baptised in the name of one God, the Father, Almighty, Maker of Heaven and Earth, and of one Lord Jesus Christ, the Son of God, and of the Holy Ghost. See: Heb. V, 12, 13, 14 and vi, 1. 2, 3.²

Newton here cites the passage from Hebrews which refers to "the first principles of God's word"³ and these verses in Scripture basically determined Newton's whole approach to theology and to his doctrine of the church. Newton is very rigid on these "fundamentals" or "first principles" of the laws of God which constitute the church, but not all points of Scripture are explicitly clear; not all doctrines belong to the "first principles" of the Christian faith, and therefore, we have this distinction between the Absolute and Relative, the Primary and Secondary, the laws of God and the laws of men, or, the laws which are the basis of communion in the church, and those which are not a matter of communion.

Newton was a communicant member of the Church of England, and he explains in an article that

The fundamental requisites to communion in the Church of England are:

1. To renounce the Devil and all his works . . . And this the Apostle calls repentance from dead works.

¹Ibid., Thesis 12, p. 41 ²Ibid., Thesis 18, p. 43.
³Heb. 5:12.
2. To profess the faith contained in the Creed usually called The Apostles' Creed. And the profession of faith in the primitive Church the Apostle calls faith towards God and resurrection of the dead and eternal judgement.

3. To keep the commandments . . . as is explained in the Church Calendar. These and baptism and laying on of hands are all the fundamental requisites to communion in the Church of England.

Newton sees the areas of 1) repentance and baptism, 2) profession of faith in the Apostles' Creed, with special emphasis on faith towards God and in the resurrection [as the focal Christological event], and 3) the area of ethics, the commandments, as the three fundamental areas which are listed as the requisites to communion in the Church of England—baptism, faith, works—in three words. For Newton repentance and Baptism are interdependent.

For baptism was unto the remission of sins, and he whose sins are remitted is in a state of salvation. I do not say that sins are remitted by baptism. They are remitted by a sincere repentance from dead works. . . .

While for Newton these three "fundamental" areas are satisfactory, they are not the only way in which he expresses them. Newton has his own form of the Apostles' Creed professed under the three headings, "Our Religion to God," "Our Religion to Jesus Christ," and "Our Religion to the Church." His section on Jesus Christ is the longest. He begins another "Irenicum" with the sentence, "And the gospel is that Jesus is the Christ." This is Newton's best sentence

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1Ibid., "The Church of England, the Creeds and Articles," p. 36.

2Ibid., "Irenicum I," Fourth Position, p. 29.


4Ibid., "Irenicum II," p. 31: Newton follows this statement by quoting I John 5:1, with the directions, "See also Luke xxiv, 21-27; 44-47; Matthew xxviii, 18-20; Luke xxiv, 49, 50. All this is the Gospel which Christ sent his disciples to teach all nations and which the first Christians were taught in catechising before baptism and communion."
summary of the "first principles" of the Christian religion. He then elaborates on this in a form much like the Apostles' Creed.

Once it has been established what the "first principles" or "fundamentals" are, however, Newton then makes it clear what purpose these principles serve.

After his citation of the above three requisites Newton goes on to say

... fundamental requisites to communion in the Church of England. And therefore to excommunicate any man for anything else is contrary to the fundamental constitution of this Church. It is to excommunicate a man who, according to the fundamental constitution and express declaration of this Church, became by baptism and laying on of hands a member of Christ, a child of God, an inheritor of the kingdom of heaven, and may be still so as much as he was at his admission into communion for anything objected against him.¹

And by "anything objected against him" Newton means "second principles," or objections not included in the fundamentals. This is the key to understanding Newton's whole stand on the Trinitarian question, for Newton immediately goes on to say,

The Constantinopolitan Creed, usually called the Nicene Creed and the Creed usually called the Creed of Athenasius are not therefore any part of the milk for babes in the Church of England, but are to be referred to the strong meats for them that are of ripe age: and therefore to fall out about them proceeds from the want of Charity. They are appointed by the Common Prayer Book to be read in the Churches upon certain occasions. And so are many parts of the Scriptures which we do not understand, as Dan. ix, x; Apoc. iv, vii, xii, 7-13; xiv, 6, 19: 1-17. We daily dispute about the meaning of these and many other parts of Scripture without falling out about them, and are allowed to do so. And so we may about the meaning of the two Creeds, notwithstanding their being read in Churches.²

After an analysis of Newton's basically Arian Christology, L.T. More makes the comment:

¹Ibid., "Church of England," p. 36.

²Ibid., pp. 36-37.
Like so many other Unitarians of the day, such as Locke, he here makes a break between reason and practice, since he maintained his affiliation with the Church of England.

In other words, it is suggested by More that it was dishonest for Newton to remain a communicant member of the Church of England. If More, and others who see Newton as a "Unitarian" had studied Newton's doctrine of the Church, they would have seen that in his own estimation he stood firm on the "fundamentals" of the Church of England, and that the Athanasian Creed was outside the fundamentals. It does not appear that this was simply an attempt on the part of Newton to justify himself, but rather arises from the fact that he is committed to the Protestant principle of sola Scriptura.

He goes on to say:

And in the 8th Article she [the Church of England] declares that the three Creeds are to be received because they may be proved by most certain warrants of holy Scripture. She doth not require us to receive them by authority of General Councils ... but only because they are taken out of the Scriptures. And therefore are we authorised by the Church to compare them with the Scriptures, and see how and in what sense they can be deduced from thence. And when we cannot see the Deduction we are not to rely upon the Authority of Councils and Synods, but may endeavour to learn from others how they may be deduced, and that others are not to fall out with us for doing so."

Newton later quotes from the 6th Article, "Holy Scripture contains all things necessary to salvation." To we shall see later, the Trinitarian formula is not at all clear to Newton as contained in Scripture, and since Scripture is his only yardstick, he not only feels justified in questioning the formula, he feels it his duty to do so. In any case, the Trinity was not among the "first principles" mentioned in Hebrews chapters five and six.

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1 L.T. More, Newton, p. 64; Lord Keynes, "Newton," makes basically the same claim, since Newton did not support William Whiston's public denial of the Trinity (p. 31).


3 Ibid., p. 38.
support this view of the church Newton points out that

In the primitive Church it was not lawful to impose any other article of religion as necessary to the remission of sins and salvation besides those which were taught from the beginning of the Gospel in catechising. For when some Christians of the circumcision would have imposed circumcision ... the Apostle Paul in opposition to them tells the Galatians, "If we or an Angel from heaven preach any other Gospel than that which we have preached, let him be accursed," Gal. i, 8.¹

Newton echoes this note often, and it is perhaps the most characteristic thread of his doctrine of the church. There were in his view, because of his study of the Scriptures, certain "first principles" which were preached by the Apostles in order to baptism and admission to communion. This was the "milk for babes," and only if one of these first principles was broken could a person be excommunicated. Here is the grounds for the paradox of both a tremendous rigidness in his theology, based on these "first principles" [basically the Apostles' Creed], together with a great latitude once a person has been admitted to communion. There can be no doubt about either his firm stand on the "first principles," or his latitude once outside them. He says,

The first principles of the Christian religion are founded, not on disputable conclusions, or human sanctions, opinions, or conjectures, but on the express words of Christ and his Apostles, and we are to hold fast the form of sound words of scripture. It is not enough that a Proposition be true or in the express words of scripture. It must also appear to have been taught from the days of the Apostles in order to baptism and communion, for baptism into the remission of sin is of divine institution, and laws of God are unalterable by men. ... Temporal laws may be made by men about the changeable circumstances of religion. ... But the Gospel which Christ sent his Apostles to preach is not alterable by human authority. It is as much the law of God as the Law of Moses was, and as unalterable.²

We have not paid particular attention to what Newton calls "first principles,"

¹Ibid., "Irenicum I," p. 29; this Galatians passage was fundamental to Newton's argument for both strict "first principles" and great latitude on non-essentials.

²Ibid., "Irenicum II," pp. 34-35.
and we will discuss his "eschatological first principles" at a later point. Our main purpose here is to try to uncover what to us is perhaps the most distinguishing feature of Newton’s theology. He is very much like Joseph Mede at this point, insisting on these rigid fundamentals, derived from Scripture, but also seeking to avoid schisms within the Protestant church. Newton was in favour of a national church, and he did not want divisions over secondary principles.

To refuse communion with any church or synagogue merely upon account of the laws of the king in matters indifferent, unless these laws are imposed not merely as laws of the civil government, but as articles of religion and communion, is disobedience to the king, and schism in relation to the Church.¹

After baptism Christians are

... to grow in grace and in the knowledge of our Lord Jesus Christ, by practising what they promised before baptism, and studying the Scriptures, and teaching one another in meekness and charity, without imposing their private opinions, or falling out about them.²

At another point Newton suggests that if a person has private ideas about worship "he may use it in his Closet without troubling the Churches with his private sentiments."³ It was certainly not part of Newton’s character to cause his fellow Christians unnecessary anxiety, and since he kept his Trinitarian opinions, and his Prophetic studies to quite an extent to himself, he thereby practised what he preached. Study of "second principles" such as the Creeds and Prophecies was of course necessary, and this is where Newton placed his greatest effort. But Newton believed in a basically simple

²Ibid., Thesis 19, p. 43.
³Ibid., "Irenicum II," p. 33.
gospel which could be comprehended by the common man, and this was the foundation of the Church, not such lofty problems as the doctrine of the Trinity and the discussion of the book of Revelation. Newton's first Query "regarding the Word Homoousios" is "Whether Christ sent his apostles to preach metaphysics to the unlearned common people, and to their wives and children?" The issues which Newton raises are very fundamental to current Protestant ecumenical discussion, including the problems of biblical authority, the "fundamentals" of the faith, and the place of the creeds. Newton's doctrine of the Church emerges in our estimation as one of the most important aspects of his work.

He has several documents which all try to give a short statement of what the church involves, and they all have much in common, but none appears to be definitive.

For Newton church polity is not a matter of salvation. While he supports the polity of the Church of England, his study of the Old Testament led him to suggest the validity of something like a Presbyterian form of Government, and he said that "The being of the Church doth not depend upon an uninterrupted succession of bishops and presbyters for governing her" because the Jewish succession was interrupted until Ezra. But polity in general is a human matter, and human authority ought not "to enter into the definition of a Church." To make human authority a matter of religion makes a person "guilty of the schism."

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1. Ibid., "Queries Regarding the Word 'Homoousios,'" p. 44.
3. Ibid., Thesis 11, p. 41.
4. Ibid., Thesis 17, pp. 42-43.
The church is continued by evangelism.

The commission to teach and baptise was given to the Apostles as the disciples of Christ, and to their disciples, and the disciples of their disciples, to the end of the world...

Perhaps the basic weakness of Newton's doctrine of the Church was that he was never able to reconcile the fact that the church is a human institution and yet, as he said, constituted by the laws of God. What is never clearly reconciled in Newton is that membership in the church is based on the "first principles" of the Gospel, but it is composed of human (fallible) beings. Sometimes he approaches the church from God's point of view, and sometimes from the human point of view. In his version of the Apostles' Creed under "Our religion to the Church" we read:

We enter into Societies (called churches), not by birth as the Jews did, but by the ceremonies of baptism, confirmation, and assemble weekly to worship God jointly by prayers and praises, and in our assemblies commemorate the death of Christ by breaking of bread and drinking of wine—the symbols of his body and blood—and submit our causes to our governors, who in every city compose a board of Elders with a President elected by the citizens under whom our Deacons take care of the poor.

What is clear in Newton is that the Church is not merely a human institution. It is only a true Church if it is true to the first principles of the gospel as they are contained in Scripture, and practises the sacraments of baptism and celebrates the "Eucharist in memory of Christ's death." Church polity is necessary, but no particular polity is a matter of salvation. The "human" aspect of the church is secondary to the divine "first principles."

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1 Ibid., Thesis 20, p. 43.
3 Ibid., "Irenicum II," p. 33.
3) Newtonian VS. Unitarian Doctrine of the Church

Despite the fact that H. McLachlan published the manuscripts which deal with Newton's doctrine of the Church, in his exposition of Newton's theology he says almost nothing concerning this central aspect of Newton's work. McLachlan is of course trying to demonstrate Newton's "Unitarianism," but when the Unitarian and Newtonian doctrine of the church are compared, we see a great gap between them.

First of all, it is doubtful that all Unitarians really consider themselves to be Christians. The twentieth century Unitarian church does not practise the sacraments of either baptism or the eucharist. Furthermore, it requires no formal creedal statement as a requirement for membership in the church. Perhaps the best short definitive statement of the Unitarian doctrine of the church has been written by G. Stephens Spinks in the Series Unitarian Statements, under the title, We Believe in the Church.¹ Not only does Spinks point out that the Unitarians require no creed, he suggests that "the non-creedal nature of our Christianity is an enrichment of institutional religion."² In other words, there is no "normative" statement for Unitarian belief, no assent to what Newton calls the "first principles" or fundamentals [such as the Apostles' Creed] is required for membership. The way in which Spinks approaches the problem of defining the church is from the point of view of "the context of human need."

In reference to the church he says

It was described long ago as "The Holy Catholic Church." I suggest that if we can see what "holy" and "catholic" mean in this context of human need, we shall be able to see what the church is.³

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¹ G. Stephens Spinks, We Believe in the Church, from the Series Unitarian Statements, (London: Lindsey Press, 1949).
² Ibid., p. 15.
³ Ibid., p. 4.
Certainly Spinks has the right to approach the problem in this way, and this is a good representation of the Unitarian position. Spinks does not even mention, however, that the phrase "The Holy Catholic Church" is usually thought of in terms of its context in the Apostles' Creed, and in Scriptures, and in the history of the Church. Rather he begins with man; for Newton this would have been to begin with "second principles;" Unitarianism historically owes much to the Enlightenment, and to the rationalism which began with Descartes. And we suggest that the Unitarians have always found much more value in the theology of Leibniz, in his "best of all possible worlds," than in the theology of Newton. Spinks, as he should properly to represent Unitarianism, defines the church in essentially humanistic, rationalistic terms.

To make Newton into a Unitarian, we should expect at least two things from McLachlan. 1) We should expect him to try to find some way to minimize the fact that Newton stood firm on the "first principles" of the Gospel, on the Apostles' Creed, and 2) we should expect him to attempt to find some way to show that Newton was basically a "rationalist" in his theology. We shall deal with each problem in turn.

Here is the way in which McLachlan talks about Newton's position on the Apostles' Creed; McLachlan says

The Creeds are no part of revealed religion; hence, with the exception of what he termed "the so-called Apostles Creed," whose phraseology is scriptural, and says nothing of the Trinity, Incarnation, Deity of Christ or personality of the Holy Spirit, there was for Newton no curb to the exercise of reason in relation to them. Theophilus Lindsey, when he turned Unitarian, retained the Apostles' Creed in the first edition of his Prayer Book.¹

First of all, McLachlan does not give us any indication of where Newton used the phrase, "the so-called Apostles Creed." It may be that such a phrase

¹ McLachlan, Newton, p. 17.
does occur somewhere in Newton's work, but we have never seen it.

What is McLachlan trying to suggest by inserting this phrase at this point, and attributing it to Newton? Does McLachlan perhaps want us to think that Newton doubted the validity of the Apostles' Creed, or that Newton looked down on it as a somehow "suspect" document?

There is one point in the work published by McLachlan where Newton makes a statement similar to the one quoted by McLachlan. At that point Newton refers to one of the "fundamental requisites to communion in the Church of England," which is "To profess the faith contained in the Creed usually called the Apostles Creed." May we suggest that when Newton refers to the creed "usually called the Apostles Creed," he does so because he is aware of the fact that the Apostles' Creed was not composed by the Apostles? He is not suggesting he does not accept its articles; he is simply being careful in a matter of historical scholarship.

After attempting (perhaps) to suggest that Newton did not completely accept the Apostles' Creed, McLachlan goes on to say, "Theophilus Lindsey, when he turned Unitarian, retained the Apostles Creed in the first edition of his Prayer Book." To compare Newton with Lindsey is indeed suggestive, for Lindsey was the eighteenth century "father" of Unitarianism. McLachlan is well qualified to speak about Lindsey, for previous to his work on Newton he had published the book, Letters of Theophilus Lindsey. In this work McLachlan includes a letter from Lindsey to a friend in which Lindsey explains his true feelings about the fact that he kept the Apostles' Creed in the first edition of his Prayer Book.

Lindsey says,

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2 Herbert McLachlan, Letters of Theophilus Lindsey, (Manchester: At the University Press, Longhams Green and Co., 1920).
I shall not be satisfied till we have expunged it, [the Creed] though my sentiments are not altered with respect to the miraculous conception. But the more one reads and thinks, the very thing itself, creed, becomes odious.1

McLachlan follows the letter with this information: "From the next edition of his [Lindsey's] Liturgy the Apostles' Creed was omitted."2

Since not all of the readers of McLachlan's discussion of Newton's theology may be familiar with his previous book on Lindsey, it would seem to us to have been helpful to the reader if McLachlan had added the above information to give us a better perspective on the attitude of Isaac Newton and Theophilus Lindsey respectively to the Apostles' Creed.

When we remember that Newton said, "The Church is constituted, and her extent and bounds of communion are defined by the laws of God, and these laws are unchangeable;"3 when we remember that for Newton the "first principles" of the Gospel were as unalterable as the laws of Moses, and when we compare this—Newton's—doctrine of the Church which is based on God's divinely revealed laws with the Unitarian doctrine of the Church which takes pride in avoiding all creedal statements, and which defines the church in terms of "the context of human need," when this comparison is made there would seem to us to be a considerable gulf between the two positions. In his article on the church Newton said, "We enter into Societies (called churches), not by birth as the Jews did, but by the ceremonies of baptism..."4 We do not see how Newton could remain consistent and yet call a church which did not practise baptism a Christian church.

1Ibid., p. 36.
2Ibid., p. 37.
Newton’s work makes it very clear that he is against any form of schism within the Church, and if the Unitarian Church really took Newton’s theology seriously we suspect that they would be left with the impression that Newton would have had them remain, as he did, a member of the Church of England where they might “wish for grace and peace from God and Christ and the Holy Ghost, and baptise in their name, and to receive the Eucharist in memory of Christ’s death.”

Having discussed McLachlan’s treatment of Newton’s position on the Creed, let us turn to the second problem which we cited above, the problem of the way in which McLachlan attempts to represent Newton’s theological “rationalism.” In reference to the Creeds and Christian doctrines McLachlan said of Newton, “there was for Newton no curb to the exercise of reason in relation to them.”

It is fundamental to Unitarians that there is “no curb to the exercise of reason” in relation to their religious beliefs. McLachlan says “Newton’s rationalism is apparent in doctrinal, biblical, and historical writings, though not equally in all.”

To show both Newton’s bias towards Unitarianism and rationalism, McLachlan quotes a passage from Maimonides’ Guide for the Perplexed which refers to God


2 Ibid., “Irenicum II,” p. 33.

3 McLachlan, Newton, p. 17.

4 Ibid.
as a rational cause.\footnote{Ibid., p. 16; McLachlan also mentions Spinoza in relation to Maimonides, suggesting in this way a link with Newton's rationalism. But Newton had none of Spinoza's work in his library according to DeVillamil's Catalogue, and he is never mentioned by Newton. Leon Roth in his work Spinoza, Descartes and Maimonides (Oxford: At the Clarendon Press, 1924), has shown the intimacy of "geometrical" and "rational" demonstration in these three men. The fact that Newton believed "Absolute Mathematical" knowledge was superior to "Relative Experimental" knowledge may have been one important instance of the way in which Newton was influenced by rationalism. The theological consequence of this would be that Newton, in theology, would elevate what Thomas F. Torrance calls "abstractive knowledge" above "intuitive knowledge" in his theological work [ Cf Torrance, Theology in Reconstruction, "Knowledge of God and Speech about him according to John Calvin," (London: SCM Press Ltd., 1965), pp. 76-98.]. We shall return to this problem after we have seen more of Newton's theology.} McLachlan does not mention that this work was not found in Newton's personal library, nor have we ever seen it mentioned by Newton. Newton used Maimonides (as we shall see later) solely as a source reference on Jewish Temple worship to assist in his interpretation of the book of Revelation. Newton could no more have accepted the way that Maimonides mixed Aristotle with Jewish theology than he could have accepted the way Aquinas mixed Aristotle with Christian theology. McLachlan later admits as much, and he even quotes the passage from Newton that says,

That religion and Philosophy are to be preserved distinct. We are not to introduce divine revelations into Philosophy nor philosophical opinions into religion.\footnote{McLachlan, Newton p. 17; cited from Newton, McLachlan (ed.), p. 58.}

What is difficult to understand is how McLachlan can be aware of this statement by Newton on the one hand, and on the other he can almost without qualification discuss Newton's rationalism. Newton's religion was a biblical religion, not a philosophical religion, and he consciously attempted to achieve this. He points out that when we want to learn more about Christ, and the various names applied to him, we are "to have recourse to the Old Testament and
compare the places interpreted with the interpretations of the New.  

And Newton then warns us what we are not to do.

So then for these names of Christ we are to have recourse to the Old Testament, and to beware of vain Philosophy, for Christ sent his Apostles not to teach Philosophy to the common people and to their wives and children, but to teach what he had taught, taken out of Moses and the Prophets and Psalms concerning Christ.

Newton does not simply think that philosophy has no place in biblical revealed religion; philosophy is vain, a waste of time. His attitude toward Roman Catholic theology, toward Descartes' 'Principles,' and his refusal even to debate with Leibniz over space and time all reflect his dislike of rationalism. We would only ask, is it a principle of Unitarianism to avoid mixing philosophy with biblical religion; does McLachlan follow the maxim "beware of vain Philosophy"?

For McLachlan to say that "there was for Newton no curb to the exercise of reason" in relation to Christian doctrines is a dreadful misrepresentation of Newton. The Scriptures were Newton's standard of truth. He believed he had an objective reference in Scripture which was just as much a creation of God as was Nature; it too embodied God's laws. Scripture was just as much a curb to the exercise of Newton's reason in theology as was nature a curb to Newton's exercise of reason in his 'Principia.' Not only did Newton stand firmly on the Protestant principle of sola scriptura; he was firmly against philosophical rationalism.

One might suggest that Newton's standard of religious truth was: sola Scriptura, non vana Philosophia. We do not believe that McLachlan's attempt to make Newton either a Unitarian or a rationalist is built on a very


2Ibid., p. 34.
solid foundation, and as one reads McLachlan's analysis of Newton one very much suspects that McLachlan is aware of the chasm between the Newtonian and the Unitarian doctrine of the church. Fundamentally, the Roman Catholic and Unitarian doctrines of the church have something in common, implicitly, if not explicitly. The Roman Catholic believes in the infallibility of Church tradition, and in particular in the infallibility of the supreme head of the church, the Pope. Unitarians, however, while not allowing for a supreme infallible single head over their church, in practice if not in principle allow each member to be his own "infallible" guide in matters of religious belief, and therefore no creed is required for church membership. Each man's "reason" is his guide; the Unitarian principle is sola ratio which must be distinguished from sola Scriptura. Unitarians, like Roman Catholics, consider the Scriptures to be useful in matters of belief, but neither submits to the sola Scriptura principle. While Roman Catholic theology has its roots in the philosophy of Aristotle through Aquinas, Unitarians tend to draw from the post-Renaissance rationalism of Descartes, Spinoza and Leibniz. Although we would not expect Newton to be totally free from the influence of humanism—-and he was not—nevertheless not to notice the difference between Newton and Thomas Aquinas on the one hand, and Newton and Theophilus Lindsey on the other, does a considerable injustice to Newton. Newton does not stop being an empirical scientist when he moves from nature to theology; he does not suddenly become a speculative metaphysician. He believes his theology is based on the express words of the Prophets, Christ and the Apostles, and he attempts to retain the form of "sound words" of Scripture.

We have attempted to suggest in this section that Newton's theology is far more complex than has been admitted up to the present time. We have also suggested that Newton's theological orientation is given a helpful perspective
if seen through his doctrine of the church, and through the politico-religious background of seventeenth century England. Newton followed the example of Lord Falkland in mixing politics and religion; his association with the Whig party was motivated by his anti-Roman Catholic bias, and his motivation for accepting the task of re-coinage may have been to ensure Protestant political stability as well as personal monetary gain. Lord Falkland and Lord Digby both used the historical method of undermining the Roman Catholic doctrine of infallibility, and the division of the church Fathers over the Trinitarian formula and over the millennium helped serve this purpose.

Newton's contemporary theologian was perhaps Joseph Mede, a fellow Cambridge scholar who like Newton was committed to basic "fundamentals," but who was also latitudinarian in terms of his doctrine of the church. Both were committed to a national church. Falkland, Mede and Newton were strongly influenced by Calvinism, but were also committed to the Episcopacy. We have therefore called them "Anglo-Puritans."

Furthermore, it has been assumed by many that since Newton held a basically Arian Christology that he was therefore a "Unitarian." We have suggested that it is very misleading to call Newton a Unitarian, and that a comparison of the Unitarian and Newtonian doctrine of the church is a helpful way of discovering fundamental differences between Newton and Lindsey (or McLachlan). Neither has it been shown that Newton is a religious rationalist, but rather Newton speaks of "vain Philosophy." His strong Protestantism, his equally strong anti-Romanism, has left him firm—in principle—on sola Scriptura, from which we may learn the "first principles" of the gospel, the laws by which God has defined the church.

B) Newton's Empirical Evidence for the Existence of God

We shall be discussing two main subjects in this section, 1) a definition or
suggestion of the form which theological empiricism might be expected to take,
and 2) we shall discuss the way in which Newton's theological empiricism, in
light of the previous definition, works itself out in a dialectic between
biblical prophecy and historical fulfilment.

1) The Concept of Theological Empiricism Applied to Christianity

Newton's scientific empiricism involved as a fundamental principle the
verification of his scientific theories. Thus Books I and II of the Principia
are followed by experimental evidence in Book III which supports Newton's theory
of gravitation, and its application to the helio-centric theory of the solar
system. It was due to the fact that Newton's experimental method made his
theory open to universal testing that it eventually received universal acceptance;
his theory was, we might say, open to verification. With the advent of
Einstein's theory of relativity, however, certain aspects of Newton's theory did
not hold up under experimental testing, and now these aspects of the theory might
be said to be in a state of falsification.

Since Newton is a Christian theologian, we are interested particularly to
know what criterion might be involved in the verification or falsification of the
Christian faith, or in the verification of the existence of the Christian God.
This type of problem has been raised by John Hick in his article, "Theology and
Verification."¹ Hick points out that the concept of "God" and the concept of
"verification" each has broad applications. He confines his discussion to the
Christian concept of God, and to verification applied to this particular case.

Hick goes on to explain:

The central core of the concept of verification, I suggest, is the removal of ignorance or uncertainty concerning the truth of some proposition. That p is verified (whether p embodies a theory, hypothesis, prediction, or straightforward assertion) means that something happens which makes it clear that p is true. A question is settled so that there is no longer room for rational doubt concerning it. The way in which grounds for rational doubt are excluded varies, of course, with the subject matter.¹

We want to point out that p may be verified when some prediction is fulfilled. When a scientist predicts an eclipse, or that the temperature of a liquid will increase as the pressure on it is increased, the prediction p will be verified when p is fulfilled. Hick points out that verification seems to imply both something about existence, and something psychological. Verification involves a correlation between existence and experience, and Hick takes special notice of the concept of prediction when he says,

Verification is often construed as the verification of a prediction. However, verification, as the exclusion of grounds for rational doubt, does not necessarily consist in the proving correct of a prediction; a verifying experience does not always need to have been predicted in order to have the effect of excluding rational doubt. But when we are interested in the verifiability of propositions as the criterion for their having factual meaning, the notion of prediction becomes central [our it]. If a proposition contains or entails predictions which can be verified or falsified, its character as an assertion (though not of course its character as a true assertion) is thereby guaranteed.²

Once having pointed out the concept of prediction as central to the concept of verification, Hick then goes on to examine the "predictive" or "eschatological" aspects of the Christian faith, and he focuses especially on the concept of the resurrection of the body, and suggests that if a person found himself "reconstituted" into a "soma pneumatikon, ('spiritual body') embodying the

¹Ibid., p. 12.
dispositional characteristics and memory traces of the deceased physical organism, and inhabiting an environment with which the soma pneumatikon is continuous as the ante-mortem body was continuous with our present world, then such a person would have an experience which would tend to verify empirically the predictions of the Christian faith.

Thus Christian eschatology is central to the attempt by theological empiricism to interpret the Christian world-view by much the same method as is employed in scientific verification. As Hick suggests,

The strength of the notion of eschatological verification is that it is not an ad hoc invention but is based upon an actually operative religious concept of God. . . . The possibility of experiential confirmation is thus built into the Christian concept of God; and the notion of eschatological verification seeks to relate this fact to the logical problem of meaning.2

Questions certainly can be raised as to whether or not a prediction made in this world (but verified in another world which we cannot be sure exists), ought to be allowed in a definition of verification. But the fact remains that the biblical faith is grounded on a considerable amount of eschatology of two types: "realized" and "unrealized" or futuristic. Hick is dealing with the

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1 Hicks, "Verification," p. 21; Hick takes a similar approach to "eschatological verification" in the final chapter of his work, Philosophy of Religion (Englewood Cliffs, N.J.: Prentice-Hall Inc., 1964). This argument by Hick is not original; in 1936 Moritz Schlick had argued in his article "Meaning and Verification," Philosophical Review, Vol. 45, pp. 339-369, "I can easily imagine e.g. witnessing the funeral of my own body and continuing to exist without a body" (p. 356). Anthony G. N. Flew, however, finds that the whole notion of "immortality" is filled with logical contradictions (Cf. his article "Can a Man Witness His Own Funeral?" Hibbert Journal, Vol. 54, pp. 242-250). We are not too concerned as to whether Hick's argument holds universal agreement among philosophers. We are simply interested in the fact that this is seen by some empiricists as a way in which the Christian faith is open to verification. For a discussion of the relation between "verification" and theological language, Cf. Thomas F. Torrance, "The Problem of Theological Statement Today," Theology in Reconstruction, pp. 46-61.

second type, but we might expect both types to be of interest to Newton if in fact his scientific empiricism is to manifest itself in his theology, allowing for the fact that verification will take a different form in theology than in natural science; there are in fact quite different forms of verification within the subject matter of science itself, as seen in the methods of physics and biology respectively. Some "predictions" of the Christian faith have been fulfilled (verified), others have yet to be fulfilled. Does the theology of Newton show any concern for the predictive aspect of the Bible?

2) Biblical Prophecy and History—Eschatological Verification

We are going to discuss four aspects of Newton's work under these headings:

a) Newton's Anglo-Puritan interpretation of history, b) the context and significance of Newton's historico-prophetic work, c) Manuel's evaluation of Newton as a historian, and d) an outline of Newton's approach to historico-prophetic theology.

a) Newton's Anglo-Puritan Interpretation of History

In his introductory chapter concerning the prophecies of Daniel, Newton made the following observation:

The Jews, before the Roman captivity, distinguished the sacred books into the Law, the Prophets, and the Hagiographa, or holy writings; and read only the law and the prophets in their synagogues. And Christ and his apostles laid the stress of religion upon the law and the prophets (Matt. vii. 12. XXII. 4. Luke xvi. 16, 29, 31. xxiv. 44. Acts xxiv. 14. xxvi. 22. Rom. iii. 21.)¹

We have seen in Newton's doctrine of the Church the parallel between the first principles of Christianity or "law of the Gospel," and the "law of Moses," both of which are unalterable. There are for Newton roughly two major sections

of the Scripture: 1) the fundamentals of belief and practice, whether the law of Moses or of Christ, and 2) the prophets. The manuscripts which relate to Newton's doctrine of the church are concerned mainly with the "law," but they are by no means the major aspect of his theological work.

In addition to the fact that the "sample" of Newton's theological work published by Horsley deals mainly with prophecies, a survey of the Sotheby Catalogue indicates that the major part of Newton's theology may be placed under the headings "Apocalypse" and "Prophecies."¹ L. T. More makes the statement, in referring to Newton's theology, "It is not necessary to comment on Newton's interpretation of the Apocalypse of St. John as it is not nearly so detailed or important [as his commentary on Daniel]."² This comment is surprising because More had access to all of Newton's manuscripts, and one would have thought it obvious that Newton spent far more time studying the Apocalypse of John than the book of Daniel. Part of the root of this misunderstanding may arise from the fact that in the Horsley edition of Newton's Opera which includes Newton's observations on Daniel and the Apocalypse, we find that the section dealing with


Daniel is by far the longer. Among the unpublished manuscripts listed in
the Sotheby Catalogue, however, one discovers that Newton was mainly concerned
with the Revelation of St. John. John is Newton's patron Saint, and he forms his theology around the
Apocalypse.

It is the temper of the hot and superstitious part of mankind, in
matters of religion, ever to be fond of mysteries; and for that
reason, to like best what they understand least. Such men may use
the apostle John as they please; but I have that honour for him as
to believe that he wrote good sense; and therefore take that sense
to be his, which is the best: especially since I am defended in it
by so great authority.

1 Newton, Opera, Vol. V, "Prophecies," on Daniel, pp. 297-435; Apocalypse,
pp. 439-491. The book of Daniel is important to Newton for at least three
particular reasons: 1) because numbers of days [i.e. prophetic years], play
such an important role in Daniel when seeking to understand "predictions of
things to come" we find "Daniel is the most distinct in order of time, and
easiest to be understood: and therefore in those things which relate to the
last times, he must be made the key to the rest" (p. 305). 2) The Christian
religion is founded on the prophecy of the seventy weeks, for here we have a
prediction of all the main periods relating to the coming of the Messiah: the
time of his birth; that of his death; that of the rejection of the Jews:
... and the time of his second coming" (p. 378). 3) Daniel serves Newton's
Anglo-Puritan doctrine of history, since the eleventh horn of Daniel's fourth
beast represents the Papacy of the Church of Rome (pp. 341-364), and Newton
even goes beyond Daniel in his final chapter by discussing "Mahuzzims," idols
which were set up for the "worship of saints" by the Christians (pp. 418-435).
In his work on Daniel Newton could follow the example of his master Joseph
Mede (Cf. Works, Vol. II, "Three Treatises Upon some Obscure Passages in
Daniel," pp. 855 ff.).

2 Sotheby, Catalogue, Lot No. 227, "A Treatise on the Book of Revelation,"
over 100,000 words; Lot No. 228, "A Treatise on the Book of Revelation," and
notes, about 150,000 words; also Lot No. 229-233; 242, pp. 64-67, etc.

3 Newton, Opera, Vol. V, "An Historical Account of Two Notable Corruptions
of Scripture," p. 530.
We suspect that if a careful study of Newton's doctrine of God is ever made, that it will be found that Newton's Christology is based on the image of the "lamb of God" slain, standing before the Throne of God, and the Apocalypse is in this sense the form of Primitive Christian worship. It is on this apparent subordination of the Son to the Father in the Apocalypse, we would suggest, that Newton's Arian tendency is rooted. Newton believed that the Apocalypse was written very early, before the fall of Jerusalem, since it refers to the temple as still-standing. The early date of authorship and authority of the Apocalypse is confirmed also by the style of the Apocalypse, which is fuller of Hebraisms than his gospel. . . . It is confirmed also by the many false Apocalypses; as those of Peter, Paul, Thomas, Stephen, Elias, and Cerinus, written in imitation of the true one. For as the many false gospels, false acts, and false epistles were occasioned by true ones; and the writing many false Apocalypses, and ascribing them to apostles and prophets, argues that there was a true apostolic one in great request with the first Christians: so this true one may well be supposed to have been written early.

Newton was also of the opinion that "The Apocalypse seems to be alluded to in the epistles of Peter and that to the Hebrews, and therefore to have been written before them." And in fact, because of the Apocalypse "the style of the epistle to the Hebrews became more mystical, than that of Paul's other epistles;

1 Ibid., "Apocalypse," Newton says in reference to Rev. Chapt. 4 ff., "The beasts and elders therefore represent the primitive Christians of all nations; and the worship of these Christians in their churches is here represented, under the form of worshipping God and the Lamb in the temple" (p. 455).


3 Ibid., Newton then goes on to refer to I. Pet. 1:7, 12; 4:13, and he also refers to the "High Priest" passage in Hebrews [4:14 ff.], (p. 442).
and the style of John's gospel more figurative and majestical, than that of the other gospels."¹

We have said that Newton saw the Apocalypse as the chief source of a true Christological definition. He believed it was the source of the phrases in the gospels which refer to Christ as

- the Light, which enlightens the world; the Lamb of God, which taketh away the sins of the world; the Bridegroom; he that testifieth, he that came down from heaven; the Son of God, & c.²

Furthermore, he says, "I do not find that Christ was called the Word of God, in any book of the New Testament written before the Apocalypse."³ This is a key statement because Newton sees an equivalence between the concept of "the spirit of prophecy" and "the Word of God" who is Christ, based on the Apocalypse. The centrality of the Apocalypse to Newton's Christology is summarized in this statement by Newton:

The Father is omniscient, and hath all knowledge originally in his own breast, and communicateth knowledge of future things to Jesus Christ; and none in heaven or earth, or under the earth, is worthy to receive knowledge of future things immediately from the Father but the Lamb. And therefore, the testimony of Jesus is the spirit of prophecy, and Jesus is the Word or prophet of God.⁴

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¹Ibid., p. 446.
²Ibid.
³Ibid.
⁴Newton, McLeachlan (ed.), "Twelve Articles," Art. 4, p. 56. Newton in Opera, Vol. V, "Apocalypse," p. 448, refers to the key passage in Revelation from which he derives this: "For the testimony of Jesus is the spirit of prophecy, ... He is clad in a robe dipped in blood, and the name by which he is called is The Word of God," (Rev. 19:10–13). By referring the concept of Christ as the "Word of God" to its prophetic context in the Apocalypse, Newton avoids the more traditional exposition of the Johannine Logos Christology usually derived from the Gospel, Jn. 1:1 ff.
But Newton also says that we must worship
Jesus alone as the Lord, the Messiah, the Great King, the Lamb of God who was slain, and hath redeemed us with his blood, and made us kings and priests.¹

Newton sees Christ in the traditional three-fold office of Prophet, Priest and King, but with Newton's interest in the Apocalypse, the prophetic and priestly (sacrificial) roles of Christ are most apparent, and Christ is particularly important because of his immediate knowledge of the future through the Father.² It is here, we believe, that Newton's Protestant empiricism makes itself shown. Newton believes that biblical prophecies pertain to "future things," and Newton maintains that it is the task of the church to study and interpret the prophecies, and predictions of the future.³ In a chapter dealing with the "Kingdoms and Churches wch are the Subject of Sacred Prophecy" we learn that

The Jews & the nations by wch they were to be captivated, & particularly the nations within the bounds of the four Monarchies are the subject of sacred prophecy in the Old Testament, & the nations through which the Christian religion was to be propagated are the subject of sacred prophecy in the new, & especially of the Apocalypse. For this Prophecy being given by Christ is a Revelation of such things as principally concern the Christian religion & therefore relate chiefly to those kingdoms in wch the Christian religion flourished most.⁴

¹Newton, McLachlan (ed.), "Twelve Articles," Art. 12, p. 57.
²McLachlan, Newton, mentions that "Polish Socinians rejected the substitutionary theory of Atonement." "Christ's function was essentially prophetic, as Newton frequently represents it" (p. 15). We find it difficult to see how Newton could reject the substitutionary theory of atonement with his emphasis on the Apocalypse, and McLachlan never actually tries to show that Newton does so. Generally, however, Socinians are more concerned with the "moral" teachings of Jesus which they consider "prophetic" rather than with "prediction" which is Newton's main concern.
⁴Newton, Unpublished Manuscript, University of Cambridge, King's College, "The Language of the Prophets," Sotheby Catalogue No. 242, p. 67; Kings MSS No. 5; Chapter 1 printed in Newton, McLachlan (ed.), pp. 119-126. Our citation from Chapter 5, p. 29.
Thus Newton believes that *history* is the subject matter of biblical prophecy, and prophetic interpretation will involve a two-fold process of historical study and of biblical prophetic exegesis. If the prophecies of Scripture are fulfilled in history, Newton will have found an empirical basis for his religious beliefs, he will have "scientific proof" that the God of the Bible is the God of history, as well as the God of Nature. There is no doubt that Newton interprets the purpose of prophecy in this way. He says, in reference to the Apocalypse,

The folly of interpreters hath been, to foretell times and things by this prophecy, as if God designed to make them prophets. By this rashness they have not only exposed themselves, but brought the prophecy also into contempt. The design of God was much otherwise. He gave this, and the prophecies of the Old Testament, not to gratify men's curiosities by enabling them to foreknow things; but that, after they were fulfilled, they might be interpreted by the event, and his own Providence, not the interpreters, be then manifested thereby to the world. For the event of things predicted many ages before, will then be a convincing argument that the world is governed by Providence.¹

Newton then goes on to say that it will be in the second coming of Christ that all the prophecies culminate, at which time the corruptions which have been introduced into the Christian faith will be removed. The second coming of Christ is focal to the Apocalypse and to Newton, and for this reason "he that will understand the old prophets, must begin with this; but the time is not yet come for understanding them perfectly, because the main revolution predicted in them [the second coming] is not yet come to pass."² All of this points to one fact: Newton believed that history has in the past, and will in the future, verify the Scriptures. Newton is a Protestant, his religion depends on the *sola Scriptura* principle; but his study of Scripture has shown him that God

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²Ibid.
acts in history, and that history empirically verifies his Protestantism. The relation between Newton's scientific method and his theological method may be expressed thus:

\[
\begin{array}{c|c}
\text{Theory} & \text{Experiment} \\
\text{Mathematical Principles} & \text{Natural Philosophy} \\
\text{Absolute Time} & \text{Relative Time} \\
\text{Biblical Prophecy} & \text{Historical Event} \\
\end{array}
\]

In other words, for Newton scientific theory seems to stand in much the same relation to scientific experiment as biblical prophecy in theology stands to historical events. Historical events provide an experimental situation which can verify prophetic theory. If we have understood correctly why Newton's scientific method succeeds, and if this relation which Newton adopts between theory and observation in his science can be called "empiricism," then we do not see why the same term may not be applied to Newton's method of theological verification. There is obviously considerable difference between Newton's method of removing doubt about God's existence and Descartes' method of \textit{cogito} and his ontological argument for God's existence. If for the sake of convention we want to point to the difference between Descartes and Newton by calling one a rationalist, and the other an empiricist, and if we also keep in mind that Newton's apocalyptic work was stimulated by his position as a Protestant in seventeenth century England, then perhaps we can best understand the basic roots of Newton's theology by calling him a "Protestant Empiricist." One might, however, argue that Newton accepts the "data" of biblical prophecy in much the same way that Descartes accepts the law of contradiction. One might ask, Is biblical prophetic theory \textit{a priori}? Newton of course finds it as part of the data of his world. Perhaps mathematics and prophecy become "empirical" for
Newton because they seem to operate in nature and history respectively, whereas Newton could not find evidence that "metaphysics" operated in either nature or history.

In referring to the passage in Newton's first letter to Richard Bentley, in which Newton said, "There is yet another Argument for a Deity,"¹ Perry Miller commented that our curiosity "never shall be satisfied"² as to what the argument was. Miller suggested the argument might be based on Newton's Optics, but it seems much more sensible to suggest that it was right at this point, in the dialogue between prophecy and history, in which Newton found empirical confirmation for the existence and Providence of a Deity, and not just any deity, but of the Providence of the Christian God, the God of the Scriptures. Newton was certainly right in suggesting that the principles on which the argument was grounded were not universally received. But if one accepts the concept of "prediction," as Hick maintains, as fundamental to the process of verification, then we can argue that it was in the study of biblical prophecy that Newton's empirical personality found its deepest religious expression.

Manual, in his work, Isaac Newton: Historian, says that his title "may require explanation. The historical works are broadly defined in this book to encompass writings which others have classified as theology."³ If Manual had been more candid, he would have said that Newton's historical studies are a necessary by-product of his religious perspective. His Protestantism, which combines with his prophetic studies, demands that he be a historian; he is not religious because he is a historian, but vice-versa. We estimate from the

Sotheby Catalogue that Newton devoted about 300,000 words to what the cataloguer defines as chronology, and over 1,000,000 words to the study of prophecy and church history; less than 500,000 words in theology can be said in any sense to be outside this area, and in fact the content of the non-prophetic material reflects Newton’s historico-prophetic perspective.

It seems a misuse of terms to call the type of theology which Newton developed either "mystical-magic" or "rational metaphysics." In fact, from his prophetic studies, Newton became convinced that the introduction of "metaphysics" into the Christian faith was one of the sources of the "Great Apostasy" from the fundamentals of the faith. In his commentary on the Apocalypse, in referring to the epistles to the seven churches, he says,

These epistles contain admonitions against the approaching apostacy, and therefore relate to the times when the apostacy began to work strongly, and before it prevailed. It began to work in the apostles days, and was to continue working till the man of sin should be revealed. It began to work in the disciples of Simeon, Menander, Carpocrates, Cerinthus, and such sorts of men as had imibed the metaphysical philosophy [our it.] of the Gentiles and Cabalistical Jews, and were thence called Gnostics. John calls them Antichrists, saying, that in his days there were many Antichrists. . . . So long the apostolic traditions prevailed, and preserved the church in its purity. 1

Newton presents a fairly traditional suggestion that the church preserved its purity more or less up to the time of Constantine with his victory in 323 A.D. over Licinius. 2 We have maintained that it is impossible to separate

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2 Ibid., p. 465. Cf also "Daniel," pp. 417 ff. "Idolatry in the form of adoration of saints was of course another key issue with the Anglo-Puritan interpretation of the "Great Apostasy," and here Newton followed the example of Mede, Works, Vol. II, pp. 767 ff.; the full title of Mede’s essay is "The Apostasy of the Latter Times; or the Gentiles Theology of Daemons Revived in the Latter Times amongst Christians, in Worshipping of Angels, Deifying and Invocating of Saints, Adoring of Reliques, Bowing down to Images and Crosses, &c., All Which, Together with the Original and Progress of this Grand Apostasy, are represented in Several Discourses upon I Tim. 4:1, 2, &c."
Newton's doctrine of God from his doctrine of the church. Newton, through his prophetic studies, believed that the early church was in a state of purity, and that the Christian church, like Israel, would depart from the true faith, from the "first principles" or fundamentals of religion. Newton believed this was especially made possible eventually through the Pope of the Roman Catholic church, who was identified with the eleventh horn of Daniel's Fourth Beast. ¹

Newton says of the Pope,

With his mouth he gives laws to kings and nations as an oracle; and pretends to infallibility, and that his dictates are binding to the whole world. ²

By "pretending to infallibility" the Pope was in a position to introduce false doctrines into the "pure Apostolic biblical faith." Thus the introduction of "metaphysical philosophy" into religion, the increased temporal power of the Pope, and the mixing of paganism with Christianity with the advent of Constantine, all combined to further the "Great Apostasy."

The way in which Newton read Christian history can easily be seen in what the Sotheby Catalogue suggests may be Newton's "Church History Compleat." ³ Some of the chapters have been arranged in the following order: "Of the first principles of the Christian Religion," "Of the Christian Religion and its corruption in its morals," "Of the corruption of the Church in Language and

³Sotheby, Catalogue, Lot No. 249, pp. 69-71; the catalogue says "Among Newton's MSS. mentioned by Catherine Conduitt in the Codicil of her Will (26 Jan. 1737) is 'A Church History Compleat'; but none with this title is recorded in the catalogue made by W. M. Godschall and Bishop Horsley in 1777 . . . The present collection probably represents the MS. Catherine Conduitt had in mind" (pp. 69-70).
Opinions," "Of the rise and dominion of the Roman Catholick Church."¹

Once we see what Newton considers to be the "Protestant" view of history—his Anglo-Puritan view—then we can begin to make sense of some of Newton's so-called "Unitarian" statements. One of Newton's "Unitarian" tracts is his treatise, "Queries Regarding the Word 'Homoousios'," and if we keep in mind his view that metaphysical philosophy contributed to the corruption of the Christian faith, then the following query is instructive:

Query 1. Whether Christ sent his apostles to preach metaphysics to the unlearned common people, and to their wives and children?²

Remembering that the Trinitarian formula was developed in 325 A.D., the fifth query takes on a proper context:

Query 5. Whether it was not pressed upon them by the Emperor Constantine the Great, a catechumen not yet baptized, and no member of the Council?³

And keeping in mind also Newton's view of the principle of "infallibility,"

Query 22. Whether Hosius, St. Athanasius, St. Hilary, St. Ambrose, St. Hierome, St. Austin were not Papists?⁴

In another treatise by Newton which supposedly reflects his "Unitarianism," we find a discussion of "Paradoxical Questions Concerning the Morals and Actions

¹Ibid., p. 70.
²Newton, McLachlan (ed.), "Homoousios," p. 44.
³Ibid.
⁴Ibid., p. 47.
of Athanasius and his Followers." This is not a theological study of the doctrine of the Trinity, however, but a historical study of what Newton considers to be the political motives of Athanasius in putting forward the Trinitarian formula. His discussion suggests that Athanasius was a rogue who plotted to discredit Arius. Whatever the verdict concerning Newton's historical study, this is not a "rational" discussion of the Trinity, but rather it is part of Newton's whole prophetic Protestant doctrine of the Church, and this is another piece of the "Great Apostasy."

Westfall, in his attempt to show that Newton was a religious "rationalist" rather than a "mystic," took note of some of Newton's observations on the Apocalypse in which Newton maintains that the prophecies are given to demonstrate God's Providence in history. Westfall says of Newton's prophetic studies,

1 Newton, McLachlan (ed.), "Athanasius," pp. 61-118: To our knowledge, no competent historian has given this work by Newton critical treatment, and we do not intend to do so here. Manuel mentions the work and its purpose, but he does not either support or undermine Newton's conclusions, (Manuel, Historian, pp. 158-59). H. D. A. Major in an article "Isaac Newton Contra Sanctum Athanasium," Modern Churchman, Vol. 40, No. 2, pp. 145-147, drew attention to the publication of this work by McLachlan, but gave no indication of the success or failure of Newton's historical scholarship. Major makes the following analysis of Newton's theology in general, however: "It was essentially Christian, essentially Biblical and essentially English: it was also very erudite and critical, but it was more. It was anti-papal and very liberal... Newton was an English Churchman of the school of the 'Judicious Hooker'—loyal to Church and Crown but who had no hesitation in representing the University of Cambridge in its opposition to the Romanizing policy of James II" (p. 147). We have called Newton an "Anglo-Puritan" which involves much of what Major says; we see Newton as "left" of Papal Rome and Anglo-Catholicism (Laud), and as "right" of Unitarianism and Non-conformist Puritanism (Baxter). Notice that Major calls Newton's theology "essentially Biblical," rather than "rationalistic" or "philosophical." Both Manuel and Major notice that Newton approaches the question of the morality of Athanasius from the viewpoint of a prosecuting lawyer. Despite Newton's "liberal" theology, he approaches it with an essentially legalistic mind--the mind of a Rabbinic scholar, and of a natural philosopher.
Newton set up a key to the symbolism in the Prophecies, and used it to translate them, and compared their meaning with the facts of history—to the vindication of the prophets of course. . . . In a word, the Observations Upon the Prophecies was not an exercise in mysticism. Closely correlated to the religious purpose of Newton's scientific work, the book testified with his science to the power and omnipotence of God.¹

Westfall understands what Newton is doing, and we agree that this cannot be called mysticism in the usual sense of the word, which Westfall defines by quoting Butler who says mysticism is "the secret knowledge or perception of God in contemplation."² It is interesting to note that Westfall sees a parallel between the purpose of Newton's scientific and prophetic work, but he says nothing about the parallel between the empirical method of the two disciplines. Westfall does not, however, go so far as to call Newton's prophetic studies a sign of his religious "rationalism," but rather he simply says that Newton's work is not "mysticism." If the idea of theological empiricism had ever occurred to Westfall, we believe he could very well have supported our thesis; as it is Westfall never tries to distinguish between empiricism and rationalism. As he uses the term, Westfall would also have to say that Newton's science is "rationalistic," which could be argued, but then the contrast between Bacon and Newton on the one hand, and Descartes and Leibniz on the other is lost.

Having missed the empirical significance of what amounts to nearly two thirds of Newton's theological work, Westfall then goes to place Newton in the same category with John Ray and John Locke who in his Reasonableness of Christianity

¹Westfall, "Rationalist," pp. 165-166.

had demanded in effect, not only that the foundation of Christianity be rationally demonstrable, but also that Christianity as a whole contain no doctrine incomprehensible to reason. Newton followed Locke instead of Boyle, shrinking the superstructure of Christianity into the foundation and embracing natural religion as the whole of Christianity.¹

To say that Newton embraced "natural religion as the whole of Christianity" is simply false, as must be obvious on the basis of our discussion in this chapter. Newton's prophetic study is the major part of his theological work, and cannot be called natural religion, but is rather based on Scripture, and assumes the continual providence of God in history.

Because of Newton's unorthodox position on the Trinity, Westfall then cites Newton's article on the use of the word "Homoousias" as evidence of Newton's religious rationalism. He says

The end product of his religious thinking was a position hardly distinguishable from what is called deism. A religion that dispensed with divine revelation and doctrine above reason, its two main tenets were belief in God and the acceptance of a rational and reasonable moral code.²

This is probably the most misrepresentative statement of Newton's religious position which Westfall makes. Newton's study of biblical chronology and prophecy alone is enough radically to separate Newton from the rationalism of both the Unitarians and the deists. As Manuel points out,

¹Westfall, "Rationalist," p. 168, [John Locke, The Reasonableness of Christianity as Delivered in the Scriptures (London: Printed for Awnsham and John Churchill, 1695)]. We believe that Newton's historico-prophetic work distinguishes him from Locke, although he had some affinity with Locke of course. Much of what Locke considered "Reasonable" would not be so considered today. Locke has a kind of Puritanism (of Ibid., p. 281-82).

Vindication of Biblical chronology became a central issue in the battle of pious Christians against the philosophers, deist and atheist. In the eighteenth century the freethinkers spitefully exalted the priority of civilizations other than that of the Jews in order to humble the pretensions to uniqueness in the Jewish dispensation and to impugn the authority of the Bible.¹

Then, in reference to Newton's Trinitarian position, Westfall says that Newton's was a "religion that dispensed with divine revelation and doctrines above reason." Newton did not believe that the doctrine of the Trinity was revealed because he did not think it biblical. If he had thought it biblical, he would have also thought it revealed. This is why one must be very careful to present Newton's doctrine of the church in evaluating his theology; as a Protestant Newton thought he could make this distinction. As to divine revelation, Jesus Christ is the one in particular through whom God reveals himself to man; from Christ we receive knowledge of the future, as well as the "first principles" of the Christian faith taught as necessary for baptism by the Apostles. Westfall simply does not understand what the Protestant doctrine of sola Scriptura entails for Newton.

If Westfall had argued that Newton thought the Trinitarian formula too complex for the common man to understand, we would agree that this is a type of rationalism. But the first query Newton raised in regard to "homoousios" was whether Christ sent the Apostles to teach metaphysics to common people.

Newton opposed the doctrine of the Trinity to some extent because it was "rationalistic" or expressed in the terms of metaphysical philosophy, rather than in the terms of the Bible. One query is,

Query 3. Whether the introducing the use of that word is not contrary to the Apostles' rule of holding fast the form of sound words?²

²Newton, McLauchlan (ed.), "Homoousios," p. 44; elsewhere Newton says we are "to hold fast the form of sound words of scripture" (Ibid., "Irenicum II," p. 34). Newton derives this principle from the "Pastoral Epistles," as I Tim. 6:3 ff., and II Tim. 1:13.
Undoubtedly Newton's chief objection to the doctrine of the Trinity was that he did not believe it was biblical, particularly since he formed his Christology on the basis of the Apocalypse which suggested to Newton a subordination of the Son to the Father. Westfall and McLachlan would be in a much better position to understand Newton's "Trinitarian" work if they paid less attention to what they call his "rationalism," and more attention to his doctrine of the Church, particularly his doctrine of *sola Scriptura*. Although we do not often agree with Lord Keynes, we do agree with his statement that Newton's unorthodox Trinitarian position was derived "not on so-to-speak rational or sceptical grounds, but entirely on the interpretation of ancient authority [i.e. Scriptures]."¹ What would trouble Newton most would be to make the doctrine of the Trinity necessary for Christian communion more than two centuries after all the Apostles were dead [325 A.D.]. What was not among the "first principles" taught by the Apostles should not be required for communion, for to do so is to "preach another Gospel," and to alter the laws of God. Thus Newton's "Anglo-Puritan" doctrine of the church involves a particular perspective on history, especially church history. And his historico-prophetic works provide empirical "eschatological verification" of his Anglo-Puritanism.

Newton is not a philosopher or a mystic.

b) The Context and Significance of Newton's Historico-Prophetic Work

Our purpose here is to mention some of the aspects of the context within which Newton carried on his historico-prophetic studies; this has already been done from a historian's point of view by Manuel, who has paid particular attention to chronologists of the seventeenth century, but we want to mention

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the theological background to this aspect of Newton's work.

In his article "The Academic Re-discovery of Apocalyptic Ideas in the Seventeenth Century," ¹ Brian G. Cooper maintained that during the 1630s there was an academic rediscovery of the millennium as a theological, exegetical concept; literal chiliasm began to be respectable again. Thomas Brightman, John Henry Alsted and Joseph Mede are the key figures in this process. Of course, this academic preoccupation with the imminent end of the world persisted, intermittently, through the 17th century—Newton regarded his rummaging into biblical chronology as more important than his experiments with physics.²

Cooper then goes on to discuss the theology of the Presbyterian Brightman who used his exegesis of Daniel and Revelation to support his polity against both Rome and the Church of England, and this prophetic system could later "be transformed to serve the ends of religious and social radicalism,"³ that is, presumably, the cause of Cromwell. Johann Heinrich Alsted was a German millenialist who used astrology in his predictions, and concluded that the power of the Papacy would be destroyed by 1694 at the latest.⁴ Cooper then mentions Joseph Mede, who was influenced by Alsted; in Mede in particular the Millennium and the Second Coming of Christ were closely linked.⁵ There is one point at which Newton radically differed with his professors, however; he said "The folly of interpreters hath been, to foretell times and things by this prophecy [the Apocalypse], as if God designed to make them prophets."⁶ In

reference to the prediction of the second return of the Jews to rebuild Jerusalem. Newton said, "The manner I know not. Let time be the interpreter." This was Newton's motto; he was not a prophet. Furthermore, Newton followed Mede rather than Brightman in his loyalty to the Anglican polity; certainly Newton believed Presbyterian polity was a valid form of church government, but polity was not one of the "first principles" of the Gospel; it belonged to the human rather than the divine aspect of the church.

Manuel has pointed out that in the fields of chronology and theology "Newton relied mainly on old authorities: John Marsham and Sigonius, a sixteenth-century historian, were his chief mentors in chronology and Joseph Mede in prophecy." There is no doubt about Mede's influence; Newton rarely mentions his reliance on any authority, but he mentions Mede on several occasions. A typical comment is "Mr. Mede hath explained the prophecy of the first six trumpets [i.e. in the Apocalypse] not much amiss."^1  

---312---

1 Ibid., p. 376.  
2 Manuel, Historian, p. 171.  
3 Newton, Opera, Vol. V, "Apocalypse," p. 474; of also p. 464. There is some question as to Newton's use of Henry More. McLachlan says of Newton, "In his bulky manuscript on 'The Language of the Prophets' he acknowledges his debt to Henry More" (Newton, p. 18). By contrast Manuel says "Newton freely admitted that he had been influenced by the mid-seventeenth-century Puritan expositor Joseph Mede (Henry More's role is somehow never mentioned)" (Historian, p. 146). We have been unable to find mention of Henry More in the manuscript to which McLachlan refers, although Newton does say in his "Language" that he has followed "the example of Mr Mede and other late writers" [Newton, McLachlan (ed.), p. 120]. Newton would probably include Henry More under the rubric "other late writers," but Mede rather than Henry More has set the standard for Newton's prophetic work. The biographer L. T. More makes note of some correspondence between Henry More and a Dr. Sharp in which Henry More admits that he and Newton were not always in agreement as to prophetic interpretation (Cf. L. T. More, Newton, pp. 629-30). The major part of Henry More's theology was devoted to mixing Plato's metaphysics with the Christian faith, and Newton's personal library shows that Newton had little interest in this aspect of the work of the Cambridge Platonist. Since Newton saw "metaphysical philosophy" as one of the tools of the Gnostic-antichrists, Henry More's rationalism may have provided some tension between them at this point.
Apocalyptic study involved historical study, and there can be no doubt that for Newton and his predecessors the Reformation, and particularly Calvinism, was the stimulus behind this aspect of biblical exegesis. But what was also common to the Protestant cause, as is visible in Lord Falkland's discourse against infallibility, and which is also seen in the work of Mede, is a certain affinity with the church fathers who were on the one hand millennialists, and on the other hand were considered to be "orthodox" by the Roman Catholics. Newton's prophetic study is thus directly linked with his study of the church fathers, and he was certainly a leading authority on the "Fathers" in his own time. Newton's prophetic interest forced Newton to be keenly aware of the problem of history, and consequently the concept of sola Scriptura did not lead Newton to ignore history as some "fundamentalist" Protestants have been tempted to do. Newton did not ignore history or tradition, but the biblical material was the basic yardstick of his personal beliefs. For Newton God made himself known in the Scriptures and in history, and the more we learned about the Scriptures, the more we understood history, and the more we studied history, the more we understood the Scriptures.

John McIntyre, in his book The Christian Doctrine of History, has pointed out that in the twentieth century the concept of history has become "one of the most intelligible vehicles of the Christian faith." By contrast, if previous generations have used the Aristotelian metaphysics, or more recently scientific concepts, not only for apologetic but also for dogmatic purposes, then we have turned to history and historical concepts for these same purposes.

For Protestants the present position is at least indirectly a result of

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2 Ibid., p. 6.
the rejection of philosophical metaphysics at the Reformation, and the continued application of a biblically oriented religion. Certainly Newton did not share the twentieth century view of history, but it is of no small importance that with his rejection of metaphysics as the "vehicle" of God's revelation and his acceptance of the Scriptures as that vehicle, he also found himself accepting history as the centre of God's providential activity. Consequently, although he was a Protestant, Newton by no means ignored Church Councils, or civil government, or the church fathers. Scripture and history combined to give Newton an empirical basis for his theology, a basis by which he could test and reject theological rationalism.

c) Manuel’s Evaluation of Newton as a Historian

Although Manuel does not point out that Newton's historical interest derives from his theology, he is certainly aware of the intimacy of the two disciplines in Newton. He says, in explaining his approach to Newton,

It also seemed necessary to relate Newton's chronology with his interpretation of prophecy and to show that these were but two aspects of a unified world view. (A simultaneous interest in chronology and prophecy was not peculiar to Newton, as the works of Bishop Ussher amply testify.)

If Manuel had more fully realized that the Scriptures provide Newton with his "historical formula" by which to interpret and predict the "meaning" of history, Manuel might have had an even greater appreciation for Newton's empirical historical method.

What is Manuel's evaluation of Newton's chronological work? Manuel presents Newton's history in the context of seventeenth century historical method, which Newton accepted as more or less valid. History was mainly a

1 Manuel, Historian, p. 13.
process whereby the events of the past are properly ordered in a chronological series. It is significant that history was somewhat "mechanical." Newton was as well prepared to study history as any contemporary:

he not only controlled the whole classical corpus and patristic literature but he read the voluminous seventeenth- and early-eighteenth-century Latin folios on the origins of religion and the diffusion of the pagan gods, and the sundry learned compilations of the religious rites of Jews and heathens, as well as the major universal histories and chronologies.1

The majority of works in Newton's library were related to history, history of doctrine, and the origin of kingdoms and religions.2 Newton was particularly well stocked in the church fathers, and in the history of the early church—between the Apostles and St. Augustine; Manuel is of the opinion that, viewed in the context of his own time, Newton was an extremely competent historian;

The literary evidence is generally related to a central astronomical argument based on the precession; fundamentally its role is corroborative. With equinoctial precession as an instrument any event in the past could be dated with certainty, provided that an ancient record could be found indicating the position of the sun at time of equinox relative to the fixed stars. Prediction of heavenly phenomena had of course been practiced since early Greek times. The aim of the Chronology was the establishment of a relationship between the observed movement of earth with respect to the fixed stars and ancient political events, so that the past might be "predicted" backward, so to speak.3

This backward prediction was based on the fact that the early Greeks possessed what Newton called a "primitive sphere" on which were marked the precessions of the constellations. Newton believed this sphere to be in the

---315---

1Ibid., p. 42.
2Ibid., p. 43; [Cf DeVillamil's "catalogue" of Newton's library.]
3Ibid., p. 68.
possession of the Argonauts, who may have drawn it up, in 939 B.C. \(^1\) And later this sphere was in the hands of Thales, who, in Newton's opinion, changed the original position of the Equinox from the 15th to the 12th degree. \(^2\) By the use of his knowledge of astronomy, and by various ancient references to astronomical positions, often in mythical writings, Newton believed he could reconstruct history. The use of myth as history Manuel calls "The Pragmatization of Ancient Myth,"\(^3\) and it is a reflection of Newton's Puritan and Pragmatic personality, his "Protestant Empirical" personality we would say, in which he tended to see historical events as the only type of valid reality.\(^4\)

One way in which Newton converted myth to history was by assuming that pagan gods were once historical kings who had been deified. This was the custom of the Babylonians, Greeks, and Egyptians, who

after the manner of those days deified their own kings, who founded their new dominion, beginning the history of their empire with the reign and great acts of their gods and heroes. Whence their gods Ammon and Rhea, or Uranus and Titaea; Osiris and Isis...\(^5\)

Newton had little use either for the metaphysical or the mystical, except in so far as it was a symbolic representation of factual history;\(^6\) euhemerism was, together with backward astronomical prediction, the chief basis of Newton's historical method. And yet one must notice with Manuel that:

\(^1\) Ibid., pp. 73 ff.
\(^2\) Ibid., pp. 76-77.
\(^3\) Ibid., pp. 103-121.
\(^4\) Ibid., p. 121.
\(^6\) Manuel, Historian, p. 156.
The great tumult over Newton's Chronology was aroused by the manner in which it employed euhemerist and scientific tools and the consequent conclusions, and the debate should be looked upon as internecine school controversy among scholars who accepted the same fundamental pragmatizing premises, rather than as a conflict among men with antagonistic methodologies. ¹

The above analysis by no means does justice to the work by Manuel, and it is not intended to do so. The study of Newton's approach to history is an extremely technical problem, which can only be understood by a historian thoroughly familiar with historical techniques of the seventeenth-century. And any thorough analysis of Newton's theology will have to be undertaken by someone who is competent to handle historical theology from the point of view of a seventeenth century Anglo-Puritan. Manuel's work is useful and competent, and it is interesting that after taking note of the various theories offered to explain Newton's religious position, such as E. A. Burtt's "metaphysical-rationalist" theory, or Lord Keynes' "mystic-magician" theory, ² Manuel concludes

My reading of the historical works sustains the image of the traditionalist [scientist] Newton, despite his heterodox views on the Trinity. . . . For Newton the most compelling proofs of the intimacy of God's relations with His creatures were to be discovered in history, not in "theology" and "vain philosophy." Religious truth was determined by the accuracy of prophetic transmission, not by the metaphysical arguments which Newton left to Samuel Clarke to develop in the correspondence with Leibniz. . . But the real evidences of Christianity, for Newton as for divines and Fathers of the Church extending back before Augustine, were historical: the narration of true events, witnessed, and the demonstration of true prophecy. This religious and secular history of the world, an apology conceived in the grand dimensions of the City of God, Newton wrote himself, with his own hand; he did not leave it to others.

The new scientific spirit pervaded Newton's most recondite antiquarian investigations. . . . The habits of the Master of the Mint and the physicist are not absent in the Bible commentator and the chronologist. ³

---317---

¹Ibid., p. 121.
²Ibid., p. 7.
³Ibid., pp. 9-10.
These indeed are our own conclusions. Manuel concludes his work by showing how the pieces of secular and religious history fit together, in his chapter "History Sacred and Profane Connected." Here Manuel points out that the Chronology and the biblical Prophecies are all part of Newton's singular world view; we suggest they are "connected" in much the same way as "theory" and "experiment" are connected in science. History takes on meaning only because of biblical prophecy. We shall now turn to Newton's specifically "theological" writings, which are of a historico-prophetic nature, and we shall give a brief outline of the way Newton approached this problem.

d) An outline of Newton's Approach to Historico-Prophetic Theology

Since Newton's theological manuscripts were sold in 1936, only two major collections of this aspect of Newton's work are now existent to our knowledge. Consequently, we can only hope to give an outline of the direction taken by Newton in his development of the historico-prophetic aspect of his theology. Since we are interested in Newton's historico-prophetic work mainly from the point of view of method, rather than of content, we believe it is possible to give a fair estimate or outline of this aspect of Newton's theology on the basis of the doctrine of the church we have developed above, on the basis of the printed theological works, on the basis of the unpublished manuscripts which are available, and on the basis of the Sotheby Catalogue of Newton's manuscripts which gives a fair indication of the subject matter of his work.

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1Ibid., pp. 139-165.

The Sotheby Catalogue listed Newton's chronology under Section VI, and his theology under Section VII. There were forty four lots sold by various sized collections, and listed under various subject headings. These subject headings might lead one to believe that Newton's work was very diversified, but in fact, inspection reveals that there is an underlying unity to the major part of Newton's theology which can only be described as historico-prophetic. The first five lots were headed "Apocalypse," and one might suppose this is all that Newton wrote related to the book of Revelation. But following one three page manuscript on "Blood," we find the heading "Church History," which is then further described as "[Notes on the site of the Seven Churches of Asia, Etc., mostly in Latin]." Newton's work also includes a history of the Nicene Council. There are seven lots listed under the classification of "Prophecies," one of which is "Observations upon the Prophecies of Daniel and the Apocalypse of St. John," and in fact all under this heading are related to Newton's historico-prophetic work. The seven lots of "Prophecies" are immediately followed by nine lots under the heading "Religion." But the first lot is further described as "The Christian Religion, an Unfinished Treatise with Special Reference to Church History and the Interpretation of the Prophecies, in English." This is perhaps the most important of Newton's unpublished manuscripts, a manuscript of about 850 pages and about two hundred thousand words in length, which perhaps was intended as "A Church History

---319---

1Sotheby, Catalogue, pp. 60-74.
2Ibid., Lot No. 232, p. 65.
3Ibid., Lot No. 233, p. 65.
4Ibid., Lot No. 241, p. 66.
5Ibid., Lot No. 245, p. 69.
6Ibid., Lot No. 249, pp. 69-70.
Compleat, and begins with a chapter "Of the Church of God and of her Laws, Sanctuary, Government." The work also includes a discussion "Of the Holy Covenant" and "Of the faith which was once delivered to the Saints." Another chapter is "Of the Roman Empire in relation to its Ecclesiastical dominion in legislature in matters of Religion," This chapter would be related to the idea "Of the first principles of the Christian Religion" on the one hand, and on the other to the authority which tried to change the laws of God first set down in the gospel, that is "Of the corruption of the Church in Language and Opinions" and "Of the rise and dominion of the Roman Catholic Church" which led to "the rule and faith and schism of the Christian Roman Empire."

Other manuscripts under the subject of "Religion" also relate to Newton's historico-prophetic work, although this is not exclusively true. The next section is related to "Roman Catholicism," three lots, one of which is further described as "[A Memorandum on the Papacy and the future of the Roman Church as supposedly revealed in the Prophecies]" and which begins

That ye Papists for some years past have had and still continue in a firm persuasion that they shall ere long suppress all parties disagreeing from them is commonly observed by those who converse much with them; why they should do so at this time more than formerly since they pretend not to any prophecy for it, must be from ye knowledge they have of ye present posture of affairs in Europe. . . .

Newton's commitment to what he considers to be the biblical "historico-prophetic" world view is well evidenced in the phrase which notes that the

---320---

1 Ibid.
2 Ibid., p. 70.
3 Ibid.
4 Ibid., pp. 70-71.
5 Cf Ibid., Lot No. 256, p. 71, a short treatise on "The Rise of Apostasy in Point of Religion."
6 Ibid., Lot No. 258, p. 72.
Roman Catholics "pretend not to any prophecy" for their hope for eventual supremacy, but only hold a rather secular political analysis of the "present posture of affairs in Europe." This is almost sarcasm on Newton's part, for it is his main contention that the Roman Catholics, and particularly the Pope, became too involved with politics, substituting the commandments of men for the commandments of God, beginning with Athanasius and the reign of Constantine. Another manuscript "against" Roman Catholicism deal with "Fundamentals" and "Of Soisme," which again reflects Newton's dialogue between the Absolute and the Relative, between the "First Principles" of God, and the laws of men which have often been preached as another [false] gospel.

The subject of "Solomon's Temple" might not appear to be related to prophecy, but in fact the further catalogue description reveals that this is 

"[A Treatise on the Temple of Solomon (in Latin)] Prolegomena ad Lexici Prophetici Partem Secundum, in Quibus Agitur De Forma Sanctuarii Judaici." Newton's interest in Solomon's Temple is very basic, and it has caused some confusion. Lord Keynes thought that this interest was part of Newton's "mysticism," for he says "Another large section [of Newton's theological manuscripts] is concerned with all branches of apocalyptic writings from which he sought to deduce the secret truths of the Universe—the measurements of Solomon's Temple, . . . " The whole book of Revelation is written in terms of the symbolism of the worship in the Jewish Temple, although expressed in Christian terms, since Christ has become the "Lamb of God" in Revelation.

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1Ibid., Lot No. 259, p. 72.

2Ibid., Lot No. 263, p. 72; this manuscript is now in the Babson Collection; Cf Babson Catalogue, Lot No. 434, pp. 196-197.

3Keynes, "Newton," p. 31.
The Apocalypse is for Newton the point of continuity between the Old and New Covenant, and this accounts for much in his Puritan doctrine of the Church.

Christian worship grew out of Jewish worship, and this is the subject of another major chapter in Newton's "Church History Compleat" which has the heading "Of the Santuary of Strength, or of the Temple and Synagogues of the Jews and Church of the Christians."1 Furthermore, it is necessary to have a knowledge of the design and function of the Temple in order to carry out a proper exegesis of the book of Revelation, and therefore Newton's description of the design, and his diagrams of the Temple, serve this purpose. Newton also included a description of Solomon's Temple in one of his manuscripts on the Chronology,2 but in fact its place really belongs in his exegesis of the Apocalypse. Not only is it necessary to understand the design of the Temple, but also its cultic function, and Newton did a considerable amount of research in this area. There is an excellent unpublished chapter in Cambridge dealing with "The Dayly worship described," that is, the Temple worship.3 In this chapter there are no less than three direct marginal references to "Maimon. Cult. Div. Tract etc.,"4 and there is no doubt that Maimonides was a major source of Newton's understanding of Jewish worship. Newton's unpublished notes include selections "Ex Maimonide de Culto Divino,"5 and we have seen that

---322---

1 Sotheby, Catalogue, Lot No. 249, p. 70.
3 Newton, King's MSS No. 5, "Language," Chapter II, pp. 7-10; Sotheby, Catalogue, No. 242, p. 67
4 Ibid.
5 Sotheby, Catalogue, Lot No. 239, p. 66, Lot No. 265, p. 73.
McLachlan thought these pointed to Newton's rationalism.\footnote{McLachlan, \textit{Newton} p. 16.} Lord Keynes undoubtedly also saw references to Maimonides in Newton's notes, and this is probably what prompted him to describe Newton at one point as "a Judaic monotheist of the school of Maimonides."\footnote{Keynes, "Newton," p. 30; Newton would have agreed with his master Joseph Mede who said that the "learned Maimonides" had "drunk too deep of the Philosophie of Aristotle" (\textit{Works}, Vol. II, p. 754). Nevertheless Both Newton and Mede found the Old Testament scholarship of Maimonides very useful in their "Anglo-Puritan" programme.} We doubt that Maimonides found the Apostles' Creed to be the central statement of his personal faith as did Newton, nor would Maimonides be likely to take the Apocalypse of John as the normative book of the Bible, and therefore to call Newton a "Judaic monotheist of the school of Maimonides" is, in our opinion, a somewhat inaccurate statement of Newton's position. Newton's interest in Maimonides and in Solomon's Temple is part of Newton's scientific [empirical] approach to the exegesis of the Apocalypse of John.

We will later refer to what might be called one "mystical" aspect of Newton's interest in the Temple, but for the most part his interest in the Temple and its worship is descriptive. In reference to the Temple we read,

This temple looked eastward, and stood in a square area, called the Separate Place: and before it stood the Altar, in the center of another square area, called the Inner Court, or Court of the Priests: and these two square areas, being parted only by a marble rail, made an area 200 cubits long from west to east, and 100 cubits broad.\footnote{Newton, \textit{Opera}, Vol. V, "Chronology," p. 236.}

It was undoubtedly his interest in reconstructing Solomon's Temple which led...
Newton to carry out research on the length of the sacred cubit.¹ In discussing the daily worship, however, Newton begins with the fact that

The Jewish service began every morning with the sounding of Trumpets, opening of the Temple & killing of the morning sacrifice together, & dressing of the Lamps immediately after.²

Then Newton moves on to exegete this worship in terms of the Apocalypse.

After this, saith John, that is, after the dressing of ye Lamps, I looked & beheld a door [the eastern door of the Temple not opening but already] opened in heaven, & I heard the first voice as the voice of a trumpet talking with me & saying, Come up hither & I will shew thee things which must be hereafter. This voice being the second sounding of the Trumpet called the Prophet up to the open door to see the solemnity of the morning sacrifice wth such other visions in the Temple as prefigured things to come.³

Thus Newton believes it is necessary to carry out research on such diverse subjects as the sacred cubit, the design of Solomon's Temple, and the "dayly worship" in the Temple, as well as research into church history and an exegetical study of the Apocalypse itself in order to understand the visions which "prefigured things to come." The discovery of the "predictions" which lead to empirical verification of biblical prophecy is no simple task.

We should also at this point refer to the linguistic aspect of Newton's prophetic work. Perhaps the main confusion in the mind of Lord Keynes concerning Newton's "mystical" world view is that Keynes has not paid close enough

¹ Cf Newton's "Dissertation upon the Sacred Cubit of the Jews and the Cubits of the several nations; in which, from the Dimensions of the greatest Egyptian Pyramid, as taken by Mr. Greaves, the ancient Cubit of Memphis is determined;" Translated from the Latin of Sir Isaac Newton by John Greaves, published in Greaves's Works, Thomas Biroh (ed.), (Vol. II, London: J. Hughe, 1737), pp. 405-433. George Sarton in his article "On a Curious Subdivision of the Egyptian Cubit," Isis, Vo. 25, (1936), pp. 339-402, finds that Newton came surprisingly close to the actual value of the cubit [c. 22 inches] despite the fact that Newton made some errors in calculation. Newton begins his dissertation by saying, "To the description of the Temple belongs the knowledge of the Sacred Cubit" (Greaves, Works, II, p. 405).

² Newton, "Language," King's MSS No. 5, p. 7.

³ Ibid., p. 8 (Italic Newton's); passage refers to Rev. 4:1.
attention to the way in which Newton treats prophetic language. Ralph V. Elliot in his article "Newton's 'Of an Universal Language'" pointed out that
Linguistic topics continued to attract Newton in his later theological work. There exists another manuscript, to my knowledge hitherto only partly published, "Concerning the Language of the Prophets," in which Newton apparently set out to examine the language of the prophets and to "fix the significance of their types and phrases." This ....... preoccupation with problems of language ...... dates back, as we have seen, to ...... his first year at Cambridge, which neither his scientific nor any of the other pursuits of an active life were able to quell.1

The use of symbolism was a natural concern for Newton in his scientific, mathematical, historic and theological work. In his opening chapter on the "Language of the Prophets" Newton begins by explaining that
He that would understand a book written in a strange language must first learn the language, and if he would understand it well must learn the language perfectly. Such a language was that wherein the Prophets wrote, and want of sufficient skill in that language is the main reason why they are so little understood. John did not write in one language, Daniel in another, Isaiah in a third ...... And this language, so far as I can find, was as certain and definite in its signification as is the vulgar language of any nation whatsoever, so that it is only through want of skill therein that Interpreters so frequently turn the Prophetic types and phrases to signify whatever their fancies and hypotheses lead them to.2

Newton is convinced that the language of the prophets is as exact and precise in its meaning as the symbols of his equations in physics. Anyone who was not a physicist might very well suppose that persons dealing in physics were "mystics," but for Newton this is far from the case. For Newton the "mysticism" of the prophets is simply a problem of symbolism. To translate this symbolism Newton tells us that he has compared various similar phrases in Scripture, compared Hebrew with other oriental languages, and studied the

"Hieroglyphical" language of the Egyptian Priests which is similar to the Hebrew prophets in its intention.

I received also much light in this search by the analogy between the world natural and the world politic. For the mystical language was founded in this analogy, and will be best understood by considering its original. 1

This analogy between the world natural and the world politic is the key which unlocks the relation between prophecy and history, because the prophetic language, (as in describing King Nebuchadnezzar as a tall tree), 2 describes historical events and persons in terms of natural events. As Newton suggests,

The whole world natural consisting of heaven and earth signifies the whole world politic consisting of thrones and people, or so much of it as is considered in prophecy; and the things in that world signify the analogous things in this. 3

The Sun and moon on some occasions represent kings and queens, but the stars represent "subordinate Kings" or bishops and "Rulers of the people of God when the Sun is Christ." 4 Newton goes on to explain the symbolisms of all terrestrial and celestial phenomena as they are used in prophetic language, and this together with his understanding of the worship in Solomon's temple enables him to move on in the third chapter of the "Language of the Prophets" to begin in the Apocalypse where he had ended in Daniel, with "The Prophecy of opening the sealed Book and of sounding the Trumpets described." 5

---326---

2 Dan. 4:10-33.
3 Newton, McLachlan (ed.), "Language," p. 120.
4 Ibid., p. 121.
Newton's historical application of prophetic symbolism is analogous in his theological work to what Manuel describes as "The Pragmatization of Myth" in Newton's chronological work.\(^1\) Newton assumed that during the process of time the ancient pagan world converted its political history into a mythological religion, whereas the Hebrew prophets \textit{foretold} in a somewhat similar "mystical" language the events which would occur within the history of God's chosen people. It is extremely difficult for anyone not technically equipped to study Newton's work to see the inner logic and consistency with which Newton approached the whole problem of man's relation to God and to history and to the Scriptures, and certainly men such as Lord Keynes who saw Newton as a "mystic-magician" and R. S. Westfall who saw Newton as a "religious rationalist" can be excused for their representations of Newton. It is also extremely difficult to place Newton in any ordinary category, but we believe that keeping in mind the whole difference in subject matter between physics and history, and of historical and theological method as it was understood by a seventeenth century Anglo-Puritan, then Newton's interest in the "predictive" aspect of Scripture in relation to history must be seen as an expression of his Protestant Empiricism. Biblical prophecy provided for Newton a continuing process of what Hick called "eschatological verification" of the existence of God and of his Providence in History.

We believe that to call Newton either a "mystic" or a "rationalist" is quite mis-representative of his theological work, and of his personality. We believe that the personality which exhibits itself in his scientific work also applies itself to his theological work. Newton is not a "scientist" in public,

\(^{1}\)Cf Manuel, \textit{Historian}, pp. 103-121.
and a "mystic" in private, nor is he a "scientist" in his work in natural philosophy, but a "metaphysician" or "rationalist" in his theological work; perhaps there is a better term than "empiricist" (such as "positivist"), but whatever name is used, Newton does not approach theology from the point of view of the a priori, but rather from what he considers to be the "given data" of religion, that is, all that is involved in historicico-prophetic Christianity. For Newton the Scriptures, like nature, provide the starting point which God has made available to man, and the prophets point to God's past, present, and future activity in history. From the fulfilment of a prophetic event Newton derives his empirical verification of the Christian faith. Newton approaches Scripture and history in a very critical manner in terms of the context of seventeenth century thought, a manner, however, which appears esoteric today. Newton's main concern is that a biblical prophecy be fulfilled on the correct chronological date.

The Bible, in its "prediction" of the "Great Apostasy," forms the foundation of Newton's Anglo-Puritan doctrine of the church, and perhaps no two elements together tell us so much about why Newton approaches theology in the way he does as 1) an awareness of his Protestant Anglo-Puritan doctrine of the Church, and 2) his empirical or experimental approach to both science and theology. That is why we call Newton a Protestant empiricist. The greatest influence of Newton's science on his theology is indirect. The influence derives from the centre of his personality, from the sceptical, searching, "scientific method" of his empirical character.

C) Newton's View of Space and Time as Related to Biblical Eschatology

Not only did Newton's historicico-prophetic studies convince Newton of the providence of God, but they also had an important further consequence of
providing an equally firm foundation for his sola Scriptura principle. As the biblical prophecies are fulfilled in history we must also be convinced that the prophets received their authority from God, and certainly the Revelation of Christ to John [the Apocalypse] was one of the most convincing documents, for Newton, of the divine authority of Christ. Since God placed his "seal of approval" on Christ by fulfilling his prophecies, then we must also heed Christ's moral and doctrinal teachings, and in fact, all of the Scriptures, especially those related to the teachings of the prophets—Moses, and other Old Testament prophets, Christ, and the Apostles—all of whom Newton considered prophets, all of their teachings thus gain divine authority. The Christian religion is not founded on men's opinions or on metaphysics, it is founded on the "express words of Christ and the Apostles" and we are to "hold fast the sound words of scripture."  

1L. T. More, Newton, says "in Newton's time the effort to replace the authority of the Roman Church by that of the Bible was an all important question" (p. 622), but More does not suggest how Newton's historic-Prophetic programme would promote this end.

2Newton, McLachlan (ed.), "Irenicum II," p. 34; Newton's doctrine of Scripture is itself worthy of considerable treatment. He was at quite an extent literalist, fundamentalist, and generally conservative in his exegesis. Newton tended on occasion to use a verse of Scripture in a manner which reminds one of the "atomic facts" of Russell and Wittgenstein (Cf. Urnson, Western Philosophy, pp. 348-49, 410-11). But Newton also took a very critical approach to Scripture; he never argues for an "infallible" Bible, but rather the transmission of the text through ancient Israel up to the present has resulted in many textual errors and corruptions which "are now scarce to be corrected," (Newton, Opera, Vol. V, "Observations on Daniel," p. 303). But Newton was well aware of the problems of textual criticism, and one of his theological works is a study of the corruptions of the Textus Receptus version of Erasmus of I John 5:7 and I Timothy 3:16 (Ibid., "Two Notable Corruptions," pp. 495-550). This treatise is not without Newton's usual anti-Roman Catholic bias, and he finds that Jerome deliberately altered I John 5:7 because as Newton says, Jerome "recommends the alteration by its usefulness for establishing the Catholic faith" (Ibid., p. 502). Both of these were "Trinitarian" texts as used in the seventeenth century, and therefore there is more involved here than mere textual criticism. It should be noted, however, that the text by Eberhard Nestle [Novum Testamentum Graece, (17th ed., Stuttgart: Privileg. Württ. Bibelanstalt, (1953)], pp. 53-61, 606], has since corrected the Textus Receptus generally along the lines suggested by Newton. One of Newton's unpublished manuscripts is described as "Variantes Lectio Apocalypticæ" [a collection of variant readings in the Greek text, compiled from KSS, and a great number of printed editions] closely written on 105 pp autograph" (Sotheby, Catalogue, Lot No. 231, p. 65). Newton was well equipped in both Hebrew and Greek, and he certainly exercised more than the usual amount of care in his handling of Scripture.
We shall now examine also Newton's eschatology, and we shall relate his eschatology to his concepts of time and space and the way in which his scientific and religious world view come together at this juncture. We shall also discuss the implications of Newton's eschatology for his doctrine of God, but we will in no way attempt a thorough or critical study of his doctrine of God. We leave this study to others. We are interested in eschatology simply as one doctrine among many others such as the doctrine of the sacraments, doctrine of God, doctrine of grace, or doctrine of works (ethics), all of which could be considered.

1) Newton's Eschatology: The Centrality of the Second Coming of Christ

There is of course no sharp distinction between Newton's historico-prophetic theology and his doctrine of the second coming of Christ. But the second coming belongs to "futuristic" rather than realized eschatology. The fulfilment of prophecy is a continuing process which will eventually culminate with the second coming of Christ and the day of Judgment, the "Day of the Lord." In this day the true church shall be revealed; in the mean time, the true church waits expectantly for the prophecies to be fulfilled, and studies them, and maintains itself in purity.

In fact Newton approaches the whole course of history from the point of view of prophecy and judgment which are intimately linked. Prophets were sent to Israel to reclaim her, and prophets were also given to the church, after which "prophecy ceased a second time" although the task of interpretation remains. Newton reminds us that

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We have Moses, the prophets, and apostles, and the words of Christ himself; and if we will not hear them, we shall be more inexcusable than the Jews. For the prophets and apostles have foretold, that as Israel often revolted and brake the covenant, and upon repentance renewed it; so there should be a falling away among the Christians, soon after the days of the apostles; and that in the latter days God would destroy the impenitent revolters, and make a new covenant with his people; and the giving ear to the prophets is a fundamental character of the true church.¹

Here again is the root of Newton's doctrine of the church; he goes on to say that the authority of emperors, kings, princes, councils, synods, bishops, and presbyters is human, but "The authority of the prophets is divine, and comprehends the sum of religion, reckoning Moses and the apostles among the prophets."² Newton then goes on to quote his favourite passage from the first chapter of Galatians, that if anyone preaches another gospel, let him be accursed. The writings of the prophets contain the basis of the holy covenant, God's judgment upon those that break it, "and predictions of things to come."³

Prophetic judgment and eschatological historical fulfilment is right at the heart of Newton's Anglo-Puritan doctrine of the church, right at the heart of his dualism between the Divine Absolute and the Human Relative.

The most important unfulfilled prediction of things to come relates to the second coming of Christ, and the day of Judgment. Newton takes Daniel as being the "most distinct in order of time...and therefore in those things which relate to the last times, he must be made the key to the rest."⁴

The prophecy of the seventy weeks in Daniel refers to the first coming of Christ, and is the prophetic foundation of the Christian faith,⁵ but Daniel

¹Ibid., pp. 304-5.  
²Ibid., p. 305.  
³Ibid.  
⁴Ibid.  
also refers to the second coming of Christ, although the book of Revelation is more complete on the second coming. The complete prophecy of Daniel concerns the Prince of the Host, and the Prince of Princes; and now in the first year of Darius the Mede over Babylon, the same prophetic angel appears to Daniel again, and explains to him what is meant by the Son of man, by the Prince of the host, and the Prince of princes. The prophecy of the Son of man coming in the clouds of heaven, relates to the second coming of Christ; that of the Prince of the host, relates to his first coming; and this prophecy of the Messiah, in explaining them, relates to both comings, and assigns the times thereof.¹

Newton's synthesis of futuristic eschatology with reference to the parousia is essentially a combination of Daniel and the Apocalypse. He says

The Apocalypse of John is written in the same style and language with the prophecies of Daniel, and hath the same relation to them which they have to one another, so that all of them together make but one complete prophecy.²

The feast in the Temple described is the feast of the seventh month, and Jewish feasts served as apocalyptic vehicles of things to come.

The passover related to the first coming of Christ, and the feasts of the seventh month to his second coming: his first coming being therefore over before this prophecy was given, the feasts of the seventh month are here only alluded unto.³

Newton has no doubt that the second coming of Christ has always been a central article of the biblical world view. He says "there is scarce a prophecy in the Old Testament concerning Christ, which doth not in something or other relate to his second coming."⁴ This was no mere passing comment from Newton.

One of the manuscripts in the Sotheby Catalogue is described as "'Prophesies

³Ibid., p. 451.
⁴Ibid., "Daniel," p. 375.
Concerning Christ's 2D Coming, [a Collection of Texts from the Bible and from the Talmud]."¹ This manuscript is described as being of about forty pages in length and containing some fifteen thousand words. In the past Newton's position on the second coming of Christ has either gone unnoticed or has been misunderstood.

Although it is very clear to Newton that the second coming will occur, how it will is not so clear. He says,

And as the prophecies of the Old Testament remained in obscurity till Christ's first coming and then were interpreted by Christ, and the interpretations became the religion of Christians; so the prophecies of both Testaments relating to Christ's second coming may remain in obscurity till that coming, and then be interpreted by divine authority and the interpretations become the religion of God's people till Christ has put all things under his feet in heaven and earth, and shall deliver up the kingdom to the Father. And therefore it is no objection against the Christian religion that the prophecies which relate to Christ's second coming remain still in obscurity.²

Manuel cited the above quotation in his work, and also immediately preceded it with the following citation from Newton, although the citation does not precede the above reference to the second coming in Newton's text. The citation is

And if any man contend for any other sort of worship which he cannot prove to have been practised in the Apostles days, he may use it in his Closet without troubling the churches with his private sentiments.³

By arranging his material in this way Manuel leaves one with the impression that Newton did not believe that the doctrine of the second coming of Christ was a central doctrine of Newton's faith, or that he would include it among the "first principles" of the Christian religion. Manuel does have the right to

¹ Sotheby, Catalogue, Lot No. 243, p. 69.
² Newton, McLachlan (ed.), "Irenicum II," p. 34.
³ Ibid., p. 33; cited by Manuel, Historian, p. 160.
suggest that in Newton's view no precise interpretation of the manner or time of the second coming ought to be imposed as a matter of belief, but the belief that the second coming will eventually occur is absolutely central to Newton, it is the event above all others which will offer what Hick calls empirical "eschatological verification" of the Christian religion. Newton says, "The event will prove the Apocalypse."¹ When the event occurs it will be interpreted by divine authority; there will then be no room for doubt. The concept of the second coming is an article of the Apostles' Creed; Christ "ascended into heaven and sitteth on the right hand of God, and from thence he shall come to judge the quick and the dead." Newton, in his discussion of the second coming, is in fact defending the doctrine against some skeptics who suggest that it should be dismissed as an article of belief.

Far from implying that the doctrine of the second coming is one which we ought to keep in our closet, in the very beginning of this article or "Irenicum" Newton sets forth some of the "first principles" of the Christian faith.

And we are to believe in one God, the father, almighty in dominion, the maker of heaven and earth and of all things therein, and in our Lord Jesus Christ, the son of God, who was born of a Virgin and sacrificed for us on the cross, and the third day rose again from the dead and ascended unto heaven, and sitteth on the right hand of God in a mystical sense, being next unto him in honour and power, who shall come again to judge the quick and the dead raised to life [our it], and who sent the Holy Ghost to comfort his disciples and assist them in preaching the Gospel.

And all this was taught from the beginning of the Gospel in catechising, that the Catechumens might know before Baptism. . .²

This is Newton's own phrasing of the Apostles' Creed, which he finds gives quite an adequate expression of his personal faith, and the articles of this


²Newton, M'Laochlan (ed.), "Irenicum II," pp. 31-32.
Creed he includes among the "first principles" which were taught before baptism, and which are necessary for communion. For Newton belief in the second coming of Christ is required for communion in the Christian church.

We would only ask at this point: Has R. S. Westfall ever found that deism, or has H. McLachlan ever found that Unitarianism, has ever made the doctrine of the second coming of Christ a central article of religious belief? Is it the characteristic of religious rationalism to make the doctrine of the second coming a focal point of belief?

Newton made the parousia central to his faith despite the fact that there has always been doubt expressed about this doctrine, even from the times of the early church, and there has been an extended debate over the "delay of the Parousia." Newton makes reference to the passage in II Peter 3:4 by saying of Peter,

He saith that because the coming of Christ should be long deferred they should scoff; saying, where is the promise of his coming? Then he describes the sudden coming of the day of the Lord upon them, as a thief in the night, which is the Apocalyptic phrase; and the millennium, or thousand years, which are with God but as a day...and our looking for new heavens and a new earth, wherein dwelleth righteousness.2


How did Newton personally cope with the problem of the delay of the second coming? He answers it from his understanding of Scripture which suggests that these prophecies of Daniel and John should not be understood till the time of the end; but then some should prophesy out of them in an afflicted and mournful state for a long time, and that but darkly, so as to convert but few. But in the very end, the prophecy should be so far interpreted as to convince many... The two prophets must ascend up to heaven in a cloud, before the kingdoms of this world become the kingdoms of Christ. It is therefore a part of this prophecy, that it should not be understood before the last age of the world; and therefore it makes for the credit of the prophecy, that is not yet understood.¹

It is extremely important to note Newton's logic that the delay of Christ's coming, and the lack of clarity as to the means of the fulfilment of his coming, "makes for the credit of the prophecy." Newton goes on to say, however, that since so many [such as Joseph Mede] seem to be succeeding in interpreting the prophecies that perhaps the last age "be now approaching,"² although he is cautious about this. For he goes on to warn that the prophecies were not intended to make men prophets, but to show God's providence. But there is not room for a Christian to doubt that the second coming will occur sometime.

For as the few and obscure prophecies concerning Christ's first coming were for setting up the Christian religion, which all nations have since corrupted; so the many and clear prophecies concerning the things to be done at Christ's second coming, are not only for predicting, but also for effecting a recovery and re-establishment of the long-lost truth, and setting up a kingdom wherein dwells righteousness. The event will prove the Apocalypse...³

In comparison with the prophecies of Christ's second coming, the

²Ibid.
³Ibid., p. 449.
prophecies relating to the first coming were "obscure." The second coming will "prove the Apocalypse," and the true Christian faith will be recovered. We believe that we can do no better than to describe this religious perspective as that of a Protestant Empiricist, who held an Anglo-Puritan doctrine of the church.

The actual task of interpreting the events which will centre about the second coming of Christ is difficult. One of the chief difficulties is that when the second coming occurs Christ will "put all things under his feet in heaven and earth."¹ There is a "heavenly" and "earthly" aspect to this eschatological event, or there appears to be an "other worldly" aspect and an "historical" aspect of the second coming. As nearly as we can discover, Newton believed that Christ is now "in heaven" in his resurrected body, but his return to earth will be an historical event. We shall attempt to treat first his heavenly concept of Christ, and then the relation between the second coming and the heavenly and historical eschatology.

2) Space and Eschatology in Newton—Heavenly Mansions

Newton is not one to speculate to any great extent concerning such ideas as the location and nature of "heaven," but he has said enough to give us some idea of how the scientist who had discovered the universal laws of gravitation could still hold a quite literal Christian eschatology. In one of Newton’s versions of the Apostles’ Creed, under the heading "Our Religion to Jesus Christ," Newton says of Christ

¹Newton, McLachlan, (ed.), "Irenicum II," p. 34.
And then he sent his disciples to teach others what he had taught them, and is gone into the heavens to receive a kingdom and prepare a place for us, and is mystically said to sit at the right hand of God, that is, to be next to him in dignity, and is worshipped and glorified as the Lamb of God, and hath sent the Holy Ghost to comfort us in his absence, and will at length return and reign above (invisible to mortals) till he hath raised up and judged all the dead, the saints in the first thousand years and the rest afterwards, and sent the wicked to places suitable to their merits. And then he will give up this kingdom to the Father, and carry the blessed (whom he hath merited by his death and redeemed with his blood) to the place, or mansion, which he is now preparing for them, for in God's house (which is the universe) are many mansions. ¹

The most striking concept in this passage is Newton's view that Christ has gone to prepare a place for the "blessed," a place or "mansion" because "in God's house (which is the universe) are many mansions." Newton has of course taken this concept from his favourite biblical author, John, who in his gospel attributed the following words to Christ:

> Let not your heart be troubled: ye believe in God, believe also in me. In my Father's house are many mansions: if it were not so, I would have told you. I go to prepare a place for you. And if I go and prepare a place for you, I will come again, and receive you unto myself; that where I am, there ye may be also. ²

It is also apparent that the idea of "my Father's house" is key to this whole passage, for the Bible sometimes uses the phrase to refer to the Temple. ³

The context of the passage in John suggests that Christ is not referring to the Temple, and that perhaps on this count Newton is justified when he says "for in God's house (which is the universe) are many mansions." But the context of John's passage is not Newton's only motive for equating God's house with the Universe. In his work on "The Language of the Prophets" Newton observes that

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¹Ibid., "Religion," pp. 54-55.

²Jn. 14:1-3; King James Translation.

³Mt. 21:12-13; Lk. 19:45-46, parallel passages.
Temples were anciantly contrived to represent the frame of the Universe as the true Temple of the great God. Heaven is represented by the Holy Place, or main body of the edifice, the highest heaven by the most Holy, or Adytum; the throne of God by the Ark, the Sun by the bright flame of the fire of the Altar, or by the face of the Son of Man shining through this flame like the Sun in his strength; . . . the Angels or inhabitants of heaven by Cherubims carved round the Temple, the Sea by the great brazen laver, the earth by the area of the Courts, and the bottomless pit, or lower parts of the earth called Hades and Hell, by the sink which ran down into the earth from the great Altar, and was crowned with a stone to open and shut. And all these parts of the Temple have the same signification with the parts of the world which they represent.1

Thus Newton is aware that the structure of the Temple is intimately linked with the design and function of God's universe. And therefore he believes he is justified on this count in equating God's house and the universe.

The Greek word ἐνδοίκησις is used only once in the New Testament to mean "dwelling(-place), room, abode . . . of heavenly dwellings,"2 and while the King James translation of John 14:2 is "mansions," the Revised Standard reading is "rooms." There is no doubt that the idea implied is a heavenly place, and it is interesting to look back on Newton's definitions of place and space in the Principia in light of his interpretation of this passage.3 Newton believed the universe was composed of several "mansions" or "compartments" or "places," and as the sink in the Temple ran down to the "lower parts of the earth called Hades and Hell," so there are places in the universe to

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2Arndt and Gingrich, Lexicon, p. 529.

3 Cf above, Chapter III, pp. 171 ff., 210 ff.
which the wicked may be sent which are "suitable to their merits."¹ We have suggested in our exposition of Newton's prophetic work that his interest in the Temple was mainly for the purpose of discovering the symbolism by which to exegete the Apocalypse, but this is not the complete motive for Newton's work. If Lord Keynes has any justification for his claim that Newton is a type of "mystic" it would seem to come at this point, for it seems quite likely that Newton very literally believed that the Jewish Temple was an excellent "microscopic" model of the Universe, and perhaps his researches on the "sacred cubit" and his diagram which modelled the Temple were in his own mind a scientific and yet somewhat mystic means of discovering the secrets of the universe.

In the General Scholium to the Principia, after arguing that God "constitutes duration and space,"² Newton refers to "St. John's Gosp. chap. xiv. ver. 2"³ in a footnote to confirm that the Scriptures equate the infinity of the universe with the infinity of God's presence in space. Newton said that Christ "is gone into the heavens to receive a kingdom and prepare a place for us." It is clear from Newton's theology, and his method of biblical exegesis,

¹Newton, McLachlan (ed.), "Religion," p. 69; DeVillamil lists "Philo Judaeus Gr. Lat. per Celenium (1640)," in his catalogue of Newton's library (DeVillamil, Newton, p. 90), and certainly Philo stressed the analogy between the Temple and the Universe; cf. Philo In Ten Volumes, Trans. F. H. Colson and G. H. Whitaker (London: William Heinmann Ltd., 1929-1962); Philo even goes so far as to suggest that the curtains of the Temple were "woven of such and so many things as the world was made of, (being) the universal temple which (existed) before the holy temple;" Cf. the Supplement, Vol. II, to Philo In Ten Volumes, "Questions and Answers on Exodus," Trans. Ralph Marcus, p. 135.

²Newton, Principia, p. 545.

³Ibid.; cf. also Manuel, Historian, p. 162.
that Newton believed in a literal resurrection, and consequently Newton believed that right now—at this moment in time—Christ is in a heavenly place or kingdom preparing a future home for the blessed.

If we keep in mind that for Newton the idea of space captured the essence of God the Father as "Spirit," we might well ask, what is the "spatial" relation between the Father and the Son at this moment in time? Newton spoke of the Father in the following terms.

We are therefore to acknowledge one God, infinite, eternal, omnipresent, omniscient, and omnipotent, the creator of all things, most wise, most just, most good, most holy...¹

The Father is the invisible God whom no eye hath seen, or can see. All other things are sometimes visible.²

The Father is immovable, no place being capable of becoming emptier or fuller of him than it is by the eternal necessity of nature. All other beings are movable from place to place.³

Newton's Puritanism and his doctrine of God which uses the concept of "volumetric space" as a model to express his concept of the Father leads him to be very strongly opposed to the use of images in worship;⁴ we are to worship God and "do it without making any image of him."⁵

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²Ibid., "Twelve Articles," Art. 2, p. 56.
³Ibid., Art. 5; compare the language of these definitions with the Westminster Confession, Chapter II (1647), "There is but one... true God, who is infinite in being and perfection, a most pure spirit, invisible, without body, parts..." [Cf. Philip Schaff, A History of the Creeds of Christendom: With Translations (London: Hodder and Stoughton, 1877), p. 762].
⁴Cf. Newton, McLachlan (ed.), "A Short Scheme," under "Idolatry," pp. 49-51; also "The Church of England," p. 36; "Irenicum II," p. 35; Cf. also Principia, p. 545, footnote; the Sotheby Catalogue describes one manuscript as "A Sermon on 2 Kings XVII, 15, 16," Lot No. 26f, p. 72. This appears to be the only sermon ever written by Newton, and from the text in II Kings the subject matter is apparently "Idolatry," for the passage refers to the worship of the "molten images of two calves."
⁵Newton, McLachlan (ed.), "Religion," p. 54.
important difference between God the Father and Jesus Christ is that Christ is now in a body, and movable from place to place, and in fact, only the Father is immovable, "All other beings are movable from place to place." We have noted that Newton holds an Arian Christology, and while we have suggested that this Christology is based on his exegesis of the Apocalypse, there is no doubt that the fact that Christ is now in a body, and is now in some "place" or "mansion" in space and time, whereas the Father is omnipresent and immovable, suggests to Newton that the Son is inferior to the Father, and since the two persons are not equal, Newton cannot support the Athanasian formula.

Newton further tells us in his Creed that after Christ ascended into heaven to prepare a place for us that Christ "is mystically [our it.] said to sit at the right hand of God, that is, to be next to him in dignity, and is worshipped and glorified as the Lamb of God." Newton is forced to say that Christ sits at the right hand of God "mystically," by which he means symbolically, because the Father is Space-Spirit like, and therefore has no physical form, and therefore Christ could not literally sit at the right hand of God. The significance of this Creedal and biblical statement, we are told, is that Christ is "next to" the Father in dignity, which again reinforces Newton's Arianism.

If we remember that Newton was able to avoid pantheism only by maintaining a radical distinction between volumetric space and mass (the created universe), we can also see why he would find it difficult to say that the incarnate Christ was co-equal with the Father.  

---342---

1 Ibid., Cf. also "Irenicum II," p. 31.
2 Cf. above, Chapter III, pp. 171 ff.
L. T. More found among Newton's papers fourteen Arguments which "show that the Son is neither coeternal with, or equal to, the Father . . . . .

2. Because the Son is called the Word: John 1:1.
5. Because the Father is greater than the Son. John XIV. 28.
6. Because the Son did not know his last hour. Mark XIII. 32,—Matt. XXIV. 36,—Rev. I.1, and v. 3.
9. Because the Son could be incarnated.¹

The final note, that Christ cannot be equal to the Father because he can be incarnated, points back to the fact that even now Christ is in a body, that he moves about from place to place, that he has gone into heaven, and he will return from heaven to carry the blessed to the place he is preparing for them. But the Father is immovable, which for Newton means that he is superior. Some of Newton's other comments on the Trinity make it clear that he believed that the Father, Son and Holy Spirit were three separate substances, and in fact he asks,

Whether Athanasius, Hilary, and in general the Greeks and Latins, did not, from the time of the reign of Julian the Apostate, acknowledge the Father, Son, and Holy Ghost to be three substances, and continue to do so till the schoolmen changed the signification of the word Hypostasis, and brought in the notion of the three persons in one single substance.²

And yet Newton in his "Common Place Book" has headings which include Deus Pater, Deus Filius and Spiritus Sanctus Deus.³ And we find Newton quoting Colossians 2:9 in reference to Christ, "For in him dwelleth all ye fulness of ye Godhead bodily,"⁴ and Newton encourages the worship of Christ who has

---343---

¹L. T. More, Newton, p. 642 cited from Portsmouth Collection.
³Newton, "Common Place," listed in McLachlan (ed.), p. 128.
⁴Newton, "Common Place," "Deus Filius," p. XII.
"redeemed us with his blood," so that the precise analysis of Newton's doctrine of God will be no easy task. When a detailed analysis is made, however, we believe that much of Newton's Arianism can be explained in terms of his concept of prophecy, and the role of Christ in the Apocalypse, and also in terms of the "spatial" relation between the Father and Son. Newton says very little about the Holy Spirit, and this is not surprising, since the "spatial" difference between the Father and the Spirit would be difficult to explain. As nearly as we can determine there is little difference for Newton between the Father and the Spirit.2

In our discussion of Newton's concept of space we suggested that Newton held a spatial trinity, of Volumetric Space, Absolute Space, and Relative Space. The first is infinite volume, and it is this that Newton compares with God the Father. Absolute Space is the space of mathematics, the world of knowledge, and Relative Space is related to bodies. Thus we might see the persons of the

---344---

1Newton, McLachlan (ed.), "Twelve Articles," Art. 12, p. 57.

2Calvin was very concerned with the problems raised by the ascension of the physical resurrected body of Christ to a "heavenly place," and the relation of the glorified body to the Lord's Supper was especially important. Calvin's Institutes were of course in Newton's library, and Calvin is very emphatic in holding that Christ ascended to heaven in a true body (Cf. John Calvin, Institutes of the Christian Religion, Vol. II, ed. John T. McNeill (London: SCM Press, Ltd., 1961), From the Library of Christian Classics, Vol. XX-XXI; on ascension see Book iv:17:26-32, Vol. II, pp. 1393-1405). We are united with Christ at the Lord's Supper because "the Spirit truly unites things separated in space" (Vol. II, Book iv:17:10, p. 1370). Calvin asks, "What is the nature of our flesh? Is it not something that has its own fixed dimension, is contained in a place, is touched, is seen?" (Ibid., iv:17:24, p. 1391). And Christ's body is limited "by the general characteristics common to all human bodies, and is contained in heaven (where it was once for all received) until Christ return in judgment [Acts 3:21]" (Ibid., iv:17:12, p. 1373). Spirit and Space are intimately linked; at the Eucharist "The bond of this connection is therefore the Spirit of Christ, with whom we are joined in unity, and is like a channel through which all that Christ himself is and has is conveyed to us" (Ibid.). The Roman Catholics invented transubstantiation to bring Christ from Heaven to earth because "it is not possible for the human mind, leaping the infinite spaces, to reach beyond heaven itself to Christ" (Ibid., iv:17:15, p. 1377).
Godhead in the following relation:

<table>
<thead>
<tr>
<th>Volumetric Space</th>
<th>Volume</th>
<th>God the Father</th>
</tr>
</thead>
<tbody>
<tr>
<td>Absolute Space</td>
<td>Knowledge</td>
<td>God the Holy Spirit</td>
</tr>
<tr>
<td>Relative Space</td>
<td>Body</td>
<td>God the Son</td>
</tr>
</tbody>
</table>

The Holy Spirit has always had a noetic function in Christian theology, so that this analogy is not out of place, except for the order of the persons. In other words, the Father for Newton is ontologically superior to the Holy Spirit and the Son, as Volumetric Space is superior to Absolute and Relative Space. The Father "constitutes" Volumetric Infinite Space by his existence, whereas knowledge belongs to the world of mathematical equations, and to confessions of faith through the Holy Spirit, through "Absolute" laws, in mathematics, and in the Church; and finally, the Incarnate Son is representative of the world of created atoms, the world of measured, visible, sensual Relative space. We also saw that since Einstein "Absolute Space" has been made subordinate to "Relative Space," that knowledge is subordinate to nature, and derived from nature. We mention this aspect of Newton's work simply to speculate as to the way in which Newton's theory of knowledge, his doctrine of space, and his doctrine of God seem to be bound up together, and if Newton's doctrine of God is ever thoroughly investigated, we believe this investigation will have to take into account the problem of the relation for Newton between God, space and knowledge. 1

1 Cf. above, Chapter III, pp. 239-240. There is in Newton a kind of "Tritheism," rather than "Unitarianism," or at least equal tendencies toward both positions. For a general discussion of the doctrine of the Trinity, Cf. Claude Welch, The Trinity in Contemporary Theology, (London: SCM Press, Ltd., 1953). Welch comments that "the predominant concern with natural religion, the empirical attitude stemming from Locke, the scientific disclosure of unity in the material world and the philosophical emphasis on 'clear and distinct ideas,' all tended to focus interest on the unity of God rather than on any notions of inner distinctions" (p. viii). But Welch says that the Trinity was more affected by rational philosophical theology (Schleiermacher) than by natural science, and by biblical criticism, which undermined the historical value of the Johannine material which had generally been used to support the Trinity. (Continue next page)
The fact that God the Father is immovable and constitutes the volumetric space of his Universe—his infinite Temple—combined with the spatial aspect of Newton's eschatology, that Christ ascended to a heavenly mansion to prepare a place for the blessed, all this led Newton to his Arianism. But this

This is a paradox in that John was Newton's Patron Saint. Whether Newton tends more toward Tri-theism or Unitarianism, see Welsh, pp. 56-67. One of Newton's difficulties is that he is concerned only with the "Nature of the God-head, and not with the "Persons." The basic Arian Christology of Newton's day was published by his friend Samuel Clarke, The Scripture-Doctrine of the Trinity, (London: Printed for James Knapton, 1712). Clarke, like Newton, avoids the "metaphysical" question by saying, "What the proper metaphysical Nature, Essence, or Substance of these divine persons is, the Scripture has no where at all declared" (p. 243).

1 We shall summarize the aspects of Newton's thought which we believe should be considered when an attempt is made to develop Newton's doctrine of God, and to explore his Arianism. 1) His doctrine of the church must be kept in mind; he, like Lord Falkland, was aware that the division of the church over the Arian question provided a point at which Protestants could reject Roman Catholic "tradition;" 2) his Anglo-Puritan interpretation of the prophecies led him to believe that Athanasius, and the Trinitarian Creed, were part of the "Great Apostasy" which began with Constantine; 3) his sola Scriptura principle led him to believe that while the Apostles' Creed was biblical, the Trinitarian Creed was not; 4) Newton's "normative" biblical book was the Apocalypse of John, in which Newton saw a subordination of the Son (the Lamb of God) to the Father; 5) since Newton allows that the Son and Father are to be worshipped, perhaps he should be seen as a "Tri-theist" rather than as a "Unitarian;" 6) Newton's dualism between Volume and Mass developed in his physics, together with his identification of the Father with the notion of Volumetric Infinite Space, results in a sharp division of the Father from the incarnate, finite Son. Newton's Space-Spirit notion of God leads him to be strongly against the use of images in religion, and perhaps the notion of incarnation would thus be contrary to his Space-Spirit idea of God. While Newton's distinction between Volume and Mass saves him from pantheism, it presents him with problems when he develops his Christology; 7) Newton believed that the Old Testament "predicted" that the Christ would be no more than a man, and in the light of his scientific concept of verification, the notion that Christ was in fact God could falsify the Old Testament prediction; 8) one other point involves Newton's concept of Revelation. See son Hobhouse, in his article "Isaac Newton and Jacob Boehme," after concluding that Newton was not a mystic, commented that "Newton has apparently no conception of the need of a theory of knowledge to bridge the gulf between God and his world" (p. 52). But Newton once made the following observation, "God has the prophecy originally in his own breast and Christ received it from God, and delivers it to his messenger, and by his messenger to John, and by John to the Churches in a continual subordination... And to deny this subordination would be to deny Jesus Christ as he is a Prophet, the only Prophet to whom God reveals himself immediately, and who is therefore called the Word of God" (cited in L. T. More, Newton, p. 643). Perhaps Newton has developed his own "Order of Being" on the lines of Aristotle and Aquinas without being aware that he has done so. And this "Order" may have contributed to his Arianism. There seems to be an order of being in both his doctrine of space and in his doctrine of God.
eschatology also provided Newton with a much needed bridge between his scientific and biblical world view. Whereas Aquinas had spoken of Christ ascending through the many spheres until he had gone beyond the outer sphere, we find Newton, who realized that Copernicus had shattered these spheres, saying instead that the Universe is like the Jewish Temple; the Universe is not Ptolemaic, and we are not to interpret Christian eschatology in these terms, but rather in terms of the biblical world view. But the temple is a microcosmic model of the Universe which Newton studied in his *Principia.* Newton discovered the laws which God had imposed on nature by studying nature; and Newton discovered the laws which God had imposed on mankind by studying Scripture. And for Newton the two worlds were not at odds, but rather they supported each other. If Newton did not make any outward attempt to reconcile his scientific and religious positions, it is because he believed that they were reconciled right at this point of the relation between space and Christian eschatology, and between the laws of nature and the laws of the Gospel. It may be that the reconciliation which Newton secured made him pay a very high price when working out his doctrine of God, but nevertheless Newton was able to work out a fairly consistent biblical theology which supported his empirical (predictive) scientific method, and his scientific definition of volumetric space and place.

3) Time and Eschatology in Newton—Linear Time in Heaven and History

The heavenly and historical aspect of Newton's eschatology meet in Newton's idea of the Second Coming of Christ. Newton accepts a basically linear view of time, as he does in his physics, and assumes that biblical eschatology operates according to any ordinary calendar, perhaps the Julian Calendar.

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1 Brewster, Newton, Vol. II, pp. 311-12, refers to Newton's manuscript on "Considerations about rectifying the Julian Calendar."
There is no suggestion by Newton that time is "circular;" eternity is simply infinite absolute time, constituted by God's duration.

We saw in his statement of the fundamentals of eschatology that Christ "will at length return and reign above (invisible to mortals) till he hath raised up and judged all the dead, the saints in the first thousand years... And then he will give up this kingdom to the Father, and carry the blessed" to the heavenly mansion.¹

Newton seems to hold to some kind of millennium, yet he is never one to be specific about the time or manner in which it will occur: let time be the interpreter. In particular is the problem of the second return and rebuilding of Jerusalem, which must precede the battle of Armagedon, the Great Battle of God Almighty.² By Newton's own admission he should not attempt to predict how this will happen, and even more difficult is the problem that this New Jerusalem is sometimes called "the Heavenly Jerusalem, the Holy City, the Lamb's Wife, the City of the Great King."³ Newton believes that the New Jerusalem will probably be heavenly rather than historical, and in fact it has probably already been built. This is the point at which Newton avoids the problems of the excesses of some of the second century chiliasts; he is not faced with carnal expectations. But it is clear that Newton believes in two resurrections, the first of the "saints," that is, the ones of special merit, and Newton tells us that in this first judgment Christ will return and reign above "invisible to mortals."

³Ibid., p. 375.
Newton does not accept St. Augustine's *City of God* as his model of the relation between the heavenly and the historical. While Newton believes in both a Civitas Dei and a terrena civitas, what is absolutely missing from Newton's work is any discussion of the qualitative difference between the two cities. Undoubtedly there is a qualitative difference, but the main difference, is that Christ's heavenly city (the Jerusalem of the millennium) is physical but invisible. And the two cities will be integrated at the end point of history in time. There is no qualitative difference between God's space and man's space, between God's eternity and man's time; the difference is only quantitative, or qualitative only in that God's space and time is infinite. Augustine had spent a considerable amount of time studying the concept of biblical "righteousness," and he had integrated this concept with Platonic idealism. The chief difference between the two kingdoms in Augustine is qualitative, not quantitative. The radical break between scholastic and empirical physics was that nature was evaluated in terms of the motion of a body in space and time in terms of quantity (mathematics), not in terms of ideal qualities. In Augustine, as in Plato, there is much concern for the human soul, and this is true of rationalism in general. But Newton's theology is almost totally devoid of any mention of the human soul, and of its "personal" relationship to other "souls" and to God. Newton was extremely consistent in his rejection of traditional Greek-Christian philosophy; it might be said that Newton's theology is mechanical.¹

The second resurrection will take place at the day of judgment, on the day

of the Great Battle. This will be historical, and in that day both the reign of the "Beast" or pagan forms of worship, including that of the Church of Rome, and the reign of the False Prophet, that is, Islam, will be destroyed.

In Newton's discussion of the "Language of the Prophets" he points out that the Prophets speak of

Moving from one place to another for translation from one office, dignity or dominion to another. Great earthquakes and the shaking of heaven and earth for the shaking of kingdoms so as to overthrow them. The creating of heaven and earth and their passing away, or, which is all one, the beginning and end of the world—for the rise and ruin of the body politic signified thereby.\(^1\)

The difficulty this creates is that in the Apocalypse we can never be certain about the meaning of the "heavenly Jerusalem" in the last three chapters. Newton tries to maintain both the "other worldly" and "historical" reading; he stands between Irenaeus and Augustine.

We find him simply looking forward to the eventual triumph of the kingdom of God, whether it be either heavenly, historical, or both. Newton simply repeats the almost exact phraseology of the last three chapters of the Apocalypse without interpretation. We will quote at length.

At the sounding of the seventh Trumpet it is said that the kingdoms of this world are become the kingdoms of our Lord & of his Christ & he shall reign for ever & ever, & that his wrath is come & the time of the dead that they should be judged & that God should give rewards unto his servants the Prophets & to the saints & to them that fear his name small & great & should destroy them wch destroy the earth: & in the repetition of that prophecy the fowles of the heaven (the blessed of the Lord) are called to the marriage supper of the Lamb & there is war between the host of heaven on white horses & the kings who destroy the earth, & the Beast & falls Prophet are taken & destroyed in the Lake of fire & the rest are slain with the two edged sword & all the fowls are filled with their flesh at the supper of the Great God, that is they take the kingdom. . . . & judgment was given unto them, and the martyrs & they that had not worshipped the Beast nor his Image. . .

\(^1\)Newton, McLachlan (ed.), "Language," p. 121.
reigned with Christ a thousand years till the battle of Gog, & after that, for ever & ever: but the rest of the dead lived not again till the thousand years were finished. This is the first resurrection.¹

It is significant that we have here an individualistic interpretation of the Resurrection, whereas the prophetic symbols represent "the revival of a dissolved dominion by the resurrection of the dead."² This is what makes it so difficult to analyse Newton's eschatology—there is a tension between the heavenly and the historical, the individualistic and the national. Perhaps it is part of the characteristic of the Apocalypse itself that both of these fabrics are inter-woven and cannot be separated, as the history of interpretation suggests. Newton makes some interesting comments about the first resurrection.

Blessed is he that hath part in the first resurrection, on such the second death hath no power. For the day of judgment must begin at the house of God. But as Christ, when he rose from the dead, conversed not with mortals unless when he thought fit to appear to his disciples for manifesting the truth of his resurrection: so when the saints & martyrs rise from the dead it is to be conceived that they converse only with one another, & appear not to mortals unless perhaps upon very extraordinary occasions. For the children of the resurrection are as the Angels in heaven. They have power over the nations & rule them with a rod of iron, but in a manner invisible to mortals, as the Angels have done hitherto.³

Newton's personal world view does include Angels, his "Common Place Book" includes a heading with quotations from Scripture, "Angeli boni et malì."⁴ Newton never explains how it is that Christ can reign above invisible to mortals to judge the dead; nor does he explain how the resurrected saints and

¹ Newton, "Language," (King's MSS No. 5), p. 28.
³ Newton, "Language," (King's MSS No. 5), p. 28.
⁴ Newton, McLachlan (ed.), p. 128.
angels can also be invisible, nor how a physical "heavenly" Jerusalem can be invisible; but it is part of his world view, dictated, he believes, by the authority of Scripture. It seems to us that, in his refusal to speculate as to the location of the heavenly mansions, and as to the means by which the dead who are resurrected are invisible to mortals, Newton shows a considerable amount of speculative restraint. In this regard he stands in contrast to some of his contemporaries such as Henry More. Furthermore, since he, like Augustine, keeps the millennium invisible, he avoids some of the excesses of Joseph Mede, and other contemporary chiliasts.

After the first resurrection and the thousand years will come the final day of judgment when "the rest of the dead live again" and they are "judged according to their works" and are saved if their name "is written in the book of life" and condemned if not.¹

We might well ask at this point, what is Newton's understanding of the criterion of judgment applied to man? Westfall suggested that Newton's rationalism brought him to reduce morality to a simple code of "love your neighbor."² But this is not quite an accurate picture of Newton's morality. Newton says, "We must be righteous, and do to all men as we would that they should do to us."³ Newton does suggest that this was the "good manners" or "ethics" taught by Christ, Noah, Socrates, Confucius "and other philosophers," and in fact

¹Newton, "Language," (King's MSS No. 5), p. 28.
²Westfall, "Rationalist," p. 169.
This is that law which the Apostles tells you was written in the hearts of the Gentiles, and by which they were to be judged in the last day. Romans ii, 12, 14, 15, also Romans i, ii. Thus you see there is but one law for all nations, the law of righteousness and charity dictated to the Christians by Christ, to the Jews by Moses, and to all mankind by the light of reason, and by this law all men are to be judged at the last day. Romans ii.¹

If Lord Keynes was correct in suggesting something of Newton's "mysticism" in relation to Newton's study of the Jewish Temple, then Westfall may have a point in linking Newton's rationalism to Newton's ethics. Yet Newton is not without biblical support at this point in discussing "the light of reason." But more important is that Newton believes in the last judgment, which later Deists and Unitarians, and rationalists in general, rejected, and furthermore Newton links judgment not simply to an undefined "love your neighbor," but to the biblical concept of righteousness. Newton goes on to say,

"Tis so great and necessary a part of the Christian religion that the righteousness of the saints is the white clothing of the Lamb's wife, Apoc. xix, 8, and the righteous go into eternal life, Matt. xxv, 46, and as Christ is righteous so every one that hath righteousness is born of God, I John ii, 29. . . . Christ is called the righteous, I John ii, 1, and by his righteousness we are saved, Rom. iii, 25; v, 18; I. Cor. i, 30; and except our righteousness exceed the righteousness of the Scribes and Pharisees we shall not enter into the kingdom of heaven, Matt. v, 20. Righteousness is . . . even the property of God himself . . . Righteousness and love are inseparable, for he that loveth another hath fulfilled the law, Romans xiii, 8-10.²

It is hardly accurate to accuse Newton of reducing morality to a simple moral code, as Westfall does. Righteousness, eschatological judgment, and love, are inseparable. This will have, however, an accompanying historical manifestation.

¹Ibid.
²Ibid., p. 53.
And at that time [the sounding of the seventh trumpet] shall Michael stand up, the great Prince whom standeth for the Children of thy people [that Michael who overcame the Dragon, that great Prince of Israel whom Daniel calls the annointed Prince, the King of Kings & Lord of Lords who comes to ye battle of the great day with an array on white horses & a two edged sword in his mouth.] And [when the king of ye north goes forth wth great fury to make many] there shall be a time of trouble such as there never was since there was a nation till that same time. And at that time thy people . . . shall be delivered . . . every one who shall be found written in the book. And many of them that sleep in ye dust of ye earth shall awake . . . to everlasting life & some to everlasting shame & contempt.1

Newton's scientific "symbolism" begins to break down when he tries to interpret futuristic eschatology, which may be fortunate, but it does not make a study of this aspect of his work easy. Furthermore, he prefers to discuss only fulfilled prophecy, and to let time interpret the future. In regard to the second coming of Christ, however, in suggesting that Christ returns and reigns above invisible to mortals during the millennium, Newton believes that Christ and his angels and the resurrected saints (of the first resurrection) are participating in the course of history even now, although invisibly. Thus there are for Newton two second comings—one invisible, the other visible. Perhaps Newton would say that the first Second Coming has occurred, with the first resurrection, and Christ is still invisible, and he will be made manifest only at the end at the second Second Coming. There does not appear in Newton, however, any hint that the thousand years reign will be on earth and visible. Here Newton avoids the unpleasant forms of chiliasm which have in the past troubled the church. If Christ is to appear again on earth, it will be for the brief period of the second resurrection which will accompany the end and judgment of history.

1Newton, "Language," (King's MSS No. 5), p. 139; this interpretation is clearly individual. This is the last page in the manuscript, and it is interesting to notice how the number of corrections in the manuscript increase as one moves forward on the prophetic calendar. This page is difficult to read because of numerous corrections.
Although Newton's futuristic eschatology is a blur of the heavenly and the historical, by suggesting that the millennium is "invisible to mortals" he is free from suggesting that the millennium will be embodied in history itself, which also keeps him free from believing that history involves progress, as E. L. Tuveson has suggested resulted from the millennial concepts of Joseph Mede and his other followers. History is thus for Newton still a process of prophecy and judgment, although some of the saints as well as Christ may now be exerting an invisible effect on history. But there will be an end point in history, which was probably determined by the time when the invisible millennium began, which apparently may have been as late as the ninth century. Newton's Protestantism led him to subscribe to the sola Scriptura principle, and for Newton this also meant non vara philosophie. His study of Scripture led him to a study of apocalyptic, and a consequent study of history. Both the Scriptures and history provided Newton with what he believed to be empirical data, which through the process of biblical prediction and historical fulfillment eventually gave Newton verification of the Providence in God in

---355---

1 Cf. Tuveson, Millennium, p. 76-84.

2 There is a final paragraph in Newton's "Language," in the final chapter (King's MSS No. 5, p. 139), which Newton has crossed out, in which he says "These numbers relating to ye time of the end... seem to me to begin either with that time A.C. 609 or perhaps a little later," and as later dates he offers the "Council of Nice A.C. 788" or the "Council of Constantinople" in "A.C. 841." But Newton would not be certain, and we cannot be certain, that Newton intended to suggest that this is the point at which the millennium (invisible above) began. L. T. More says that in one of Newton's manuscripts Newton "confidently predicted" that the fall of the papal power of Rome "would happen about the year 2000 A.D." (Newton, p. 629). [This may have been in Newton's manuscript "A Memorandum on the Papacy and the future of the Roman Church as supposedly revealed in the Prophecies," Sotheby, Catalogue, Lot No. 258, p. 72.] This would presumably be at the Second Coming of Christ and the Day of Judgment, and would depend on the time chosen for the "Sixth Trumpet," for the "Seventh Trumpet" would apparently follow in 1000 years.
history (as well as in nature), and evidence of the validity of the sola Scriptura principle. The Christian religion is founded on the express words of Christ and the Apostles, which includes the Apocalypse, the great prophecy of the future given by Christ to John. When the visible second coming and the second resurrection occur, "the event will prove the Apocalypse." All men raised from the dead and judged will experience what Hick calls "eschatological verification."

The best of the church fathers were interested in the Apocalypse; "Irenaeus, who was contemporary with Melito, wrote much upon it; ... and so did Tertullian; ... and I do not indeed find any other book of the New Testament so strongly attested, or commented upon so early as this... This was the state of the Apocalypse, till the thousand years being misunderstood, brought a prejudice against it: and Dionysius of Alexandria, by noting how it abounded with barbarisms, that is, with Hebraisms, promoted the prejudice so as to cause many Greeks in the fourth century to doubt of the book."¹

The millennium was "misunderstood," that is, assumed to be literally historical, rather than physical and invisible, as Newton took it to be. We can imagine Newton’s opinion of Dionysius who suggested that the Apocalypse was full of "barbarisms;" Newton certainly stood with Tertullian who had asked, "What has Athens to do with Jerusalem?"² Newton’s notes on the church Fathers include many references to Irenaeus and Tertullian, and any definitive study of Newton’s prophetic work should attempt to analyse his indebtedness to the Fathers at this point, including his notes headed "Testimonies of ye Millennium."³

Realized and unrealized eschatology provided Newton with his programme of theological verification; and the "heavenly mansions" and "volumetric space" and "infinite absolute time" were constituted by Almighty God who governed nature and history. The laws of nature and the laws of the Bible all combined to give Newton a fairly unified scientific and religious world view. We call him a Protestant empiricist.
Conclusions and Observations

This paper began with an investigation of the Presocratic background to the Greek concepts of time and space, and in the light of Newton's attempt to return to the ancients—to the Presocratics—this appears to have been a valid starting point. Of course Newton had studied the early Greeks through Plato and Aristotle, and in his University life Newton seems to have studied Cartesian-Aristotelian concepts of space in particular, and only through his development of the concept of mass was he able to establish a dualism between volume and mass which then allowed Newton to see Volumetric Space as something like Plato's Receptacle of the Universe. Newton's Anglo-Puritan doctrine of the church and of history has much in common with his high regard for the ancient Greek scientists, especially for the Pythagoreans. Philosophy began to decline with Aristotle, and the Church began to decline with Constantine and Athanasius. To learn the secret of the ancients required the careful study of "objective" material. As Nature was the object of his inductive scientific method, so the Bible and History were the objects of his inductive historico-theological method. Newton was anti-metaphysical in both his science and his theology; he would say that metaphysical "hypotheses are not to be regarded in Experimental Philosophy," and "That religion and Philosophy are to be preserved distinct. We are not to introduce divine revelations into Philosophy nor philosophical opinions into religion." When we remember that in Newton's opinion Greek philosophy began to decline with Aristotle, and that Aquinas made Aristotle the Philosopher of the Roman Catholic Church, then we can see that Newton's Protestantism and his inductive scientific method combined to good advantage in giving Newton a unified personality and worldview. This is why we believe that one is well under way to understanding the
way in which Newton thought if one tries to conceive of him as a "Protestant empiricist." These two elements together, in the light of his seventeenth century scientific and politico-religious situation, seem to go a long way in explaining the various aspects of his personality. Of course Newton did not succeed in setting himself free from metaphysics—or from Aristotle entirely—but the fact that he attempted to reject metaphysics is important. And although there is much in his discussion of the relations among God, Space and the Temple which might be described as mystical, Newton is a little too practical to be called a mystic. Because of his strong doctrine of Providence he undoubtedly wondered how God created the world; perhaps he did suppose that something like the "Spirit of God" is the "cause" of gravity. But Newton's occasional conjectures are far from the mentality of Jacob Boehme, or even from the mystical-metaphysical work of Henry More.

Neither does Newton seem to be easily classed with the "common sense" rationalism of Locke. Locke was quite willing to reject the past, and to rely on "common sense," whereas Newton believed that ancient opinion—Moses, Christ, and the Pythagoreans—was worth saving. Newton's historico-prophetic theology sets him apart from Locke—Newton's sentiments lie more closely with Joseph Mede. Certainly Newton had much in common with Locke, but he also had much in common with Descartes. The differences, however, between Newton on the one hand, and Descartes and Locke on the other, must not be missed. Newton was a scientist, not a philosopher.

1) The eschatological implications of Newton's understanding of time seem to have more in common with Aristotle than with Plato. Newton's historico-prophetic theology is a proof of the existence and providence of God based on the assumption of an Absolute Time with "flows equably" and which
can be numbered. For Aristotle time was the numbering of before and after, whereas for Plato time as the moving image of eternity, in our opinion, was closely linked with an "existential" interpretation of time. This is one reason that Platonic thought was open to the type of personal theology developed by Augustine. It is surprising that Descartes, who stands in this subjective tradition, has little concern for time. But in fact the attempt by Descartes to view the universe as a machine in which things only appear to change perhaps resulted in a deliberate act on the part of Descartes to concentrate on space rather than on time. If time is more external for Aristotle than for Plato, the same "externality" applies to Newton. Because time can be numbered exactly, God's biblical prophets, such as Daniel and John, can "predict" historical events to the exact day or year. And when these predictions are fulfilled, God's providence is demonstrated.

Perhaps Newton has something in common with Aquinas in his interest in the proofs for the existence of God, although Newton's "proof" is unique. It is not surprising, however, that Newton finds the argument from design convincing, and probably the argument from First Cause. But Newton seems to have little use for the ontological argument; Newton's method of "theological verification" in our opinion has a striking parallel with his scientific method of experimental verification. It may not be suggesting too much to say that perhaps philosophers and historians of science can learn something about Newton's understanding of the "method of verification" by studying his historico-prophetic theology. Newton's theological work can serve as a "control" with which to compare his dialogue between theory and experiment in his science. It is interesting to suppose that perhaps Newton's "natural theology" and "eschatological" (realized) historico-prophetic theology both have the common purpose of, in the words of
William A. Beardslee, "providing an environing stability for the newly present saving presence of God,"\(^1\) that is, Newton's theology attempts to "objectify" God's presence in the world, he is interested to make God "accessible." Here perhaps Newton has something in common with C. H. Dodd.

Because Time (ontologically) is constituted by the duration of God, Eternity is simply infinite time. Newton would perhaps appreciate Oscar Cullmann's "time-line," which not only appears to be geometric, but also, according to Cullmann, in New Testament thought eternity is not "qualitatively different from time."\(^2\) Newton does not see any qualitative difference between time and eternity, but the basis of this opinion does not seem to lie in his New Testament studies so much as in the fact that his mathematical-scientific work has conditioned him to think of time only in quantitative terms.

Nevertheless, his realistic eschatology, and his doctrine of the Second Coming of Christ make it possible for Christ to "move back and forth" between heaven and earth without having to "break" any time barriers. There is thus a continuity between heavenly and earthly history. It may be that Newton's understanding of "Infinite Eternal Time" makes the concept of the resurrection of the body more intelligible than might some other concept of eternity.

2) The eschatological implications of Newton's understanding of space seem to have greater consequences for his theology, and receive greater consideration, than his concept of time. Since Space ontologically, like Time, is a consequence of the existence of God, it is eternal, and uncreated. Space provides Newton with the "model" by which he represents in his own mind the


\(^2\)Cullmann, Christ and Time, p. 63.
understanding of the omnipresence of God, in much the same way as the Hebrews understood the concept of "Spirit" or "breath." There is not enough evidence to determine exactly how this concept fits in with his occasional speculations on the "aether." Because Newton uses the concept of "Volumetric Infinite Space" as his model of God the Father, we find that he never seems to distinguish between the Father and the Holy Spirit. Newton's equation for density, mass and volume provides the basis of his body-space dualism, and this dualism creates a sharp contrast between the "Infinite Volumetric Immaterial Father" on the one hand, and the "Incarnate Finite Son" on the other. This dualism undoubtedly contributed to Newton's Arian Christology, because a sharp contrast between the "substance" of the Father and Son resulted—between the "spatial" Father and "bodily" Son.

Because Space is infinite Newton does not have Christ ascend "beyond the outer sphere" as we found in Aquinas. Of course the Copernican revolution had destroyed the "solid orbs" for Newton, and so he had to approach the problem of the ascension from a different cosmology. Newton takes the passage in John 14:1 ff. as the normative biblical view of the spatial construction of the Universe. God's house—the Temple and the Universe—has many "mansions" or rooms. Christ ascended to one of these heavenly places to prepare a place for the elect, and he will eventually return from heaven to raise and judge the dead, and take the elect back to the place he has prepared for the blessed. The wicked will also be sent to places "suitable to their merits." When discussing the relation between God and Space in the General Scholium to the Principia Newton refers to this key passage in John, and in a sense it is a link between Newton's scientific and biblical world view, and to our knowledge, historians of science have generally ignored this link.
study of the Temple is linked with his concept of God and Space. Newton does not explain how the resurrection will take place, although in conjunction with his Apocalyptic studies he suggests that the "elect" who take part in the first resurrection may be raised invisibly, although bodily, and that they may not converse with mortals except on special occasions. Newton's millennium seems to be invisible, and thus he avoids the chiliasm of some of his contemporaries, although his symbolic interpretation of a literal "Apocalypse," with his analogy between the "world natural" and the "world political," suffers at this point.

In our study of Plato we saw that the human "soul" seemed to be related to the universe after the mode of a geometric point. This notion seems to have been carried on by Augustine, and later by Aquinas, who speaks of Angels as geometric points, and Descartes developed a dualism between extended body and unextended mind which Leibniz then transformed into a "Monad." One suspects that God for Leibniz is much like a geometric point, whereas in Newton God is like Infinite Volumetric Space. Leibniz seems to see God as a geometric "microcosm," whereas for Newton God is more like a Euclidean geometric volumetric "macrocosm." One may well ask, Has geometry been the underlying science which has led each to these apparently opposite opinions? Is there really that much difference between the positions of Leibniz and Newton? If Newton shows signs of rationalism, it would seem to be in the way in which geometry forms a model for his pattern of thought.

3) Newton's concepts of time and space also have an epistemological function as we saw it derived in the Scholium to the *Principia*. His dualism between the Absolute and Relative, between the world of mathematical Laws and Theory on the one hand, and the observed world of Experiment and Experience on
the other, is the heart of his scientific method. Absolute and Relative Space and Time do not have an ontological function so much as an epistemological function, and this fact has often gone unnoticed by men such as Burtt and Koyré. Furthermore, his scientific method seems to be applied in his theology as well as his science, and we demonstrated the parallel between his scientific and theological method by using a "formula." Some of the concepts which we examined may be seen to stand in the following relation:

- Absolute Space : Relative Space
- Absolute Time : Relative Time
- Mathematical Theory : Experimental Evidence
- Mathematical Principles : Natural Philosophy
- Biblical Prophecy : Historical Fulfilment
- Laws of God : Laws of Man
- First Principles : Second Principles (of Gospel)
- Apostles' Creed : Church Polity

To quite an extent the "Laws of Nature" such as Newton's law of gravitation is one of God's laws, and this law, if properly discovered, is Absolute. As we discover God's laws in Nature by studying nature, so we discover God's religious laws by studying the Bible. The "first principles" of the Christian religion are not founded on vain philosophical opinions, they are founded on the express words of Christ and the Apostles. Just as "scientific experiment" is a human activity, often filled with error, so is Church government a human activity, and filled with error. When the Christian religion was first established it was "Pure," but "all nations have since corrupted" it.¹

Newton's religious writings do not reveal a high regard for man—Newton does not seem to exhibit the confidence which Martin, Tuveson and Bury found in common with the thought which led to the Enlightenment and the Idea of Progress. Newton's confidence seems to be in his belief that God is really acting in Nature and in History, and in his belief that somehow God has started an act in Christ which he will decisively finish with the Second Coming of Christ, and this event will prove the Apocalypse, this event will provide the ultimate experiential "verification" of the Christian religion.

The strong parallel between the way in which Newton works between theory and experiment in his science, and between prophecy and fulfilment in his theology, or between the Creedal statements of faith and their objective place in the Bible, has led us to suggest that Newton might well be seen as a "religious empiricist." And his type of religious empiricism must be seen through his Anglo-Puritan (Protestant) doctrine of the church. It may be that Newton's "Puritan" mentality has had greater consequences for his scientific thought (as he attempted to return to the Presocratics) than has generally been recognized. Whether or not in the future scholarship will agree that Newton should be seen as a "Protestant empiricist," we are convinced that extreme caution must be exercised in calling Newton either a "religious rationalist" or a "religious mystic." Perhaps there is something mystical in Newton's notion of the relation between God and Space; it may be that Newton was too scientific in applying his mathematical notion of "prediction" to his historico-theological work, and thus was influenced by a mathematical-geometrical rationalism. But generally the "mystic" and "rationalist" formulas seem to account for only a very limited aspect of Newton's theological work; Newton was too practical to be a mystic—he was
quite willing to work at the Mint, and as in his science, so in his theology, he tried to exclude philosophical-metaphysics from his work. This makes it difficult to see him as a rationalist—or as a Unitarian.

It has been the policy of critics of Newton’s theology such as R. S. Westfall to say that while Newton made momentous discoveries in science, "in religion, although he labored over his manuscripts with painful care, he produced nothing exciting and little new."¹ Or as Stephen Toulmin has expressed it, Newton seems to be a “complex mixture of the keen-sighted natural scientist and the naif philosophical theologian.”² We cannot help thinking that perhaps some of Newton’s supposed "theological ignorance" may be due to the lack of theological understanding on the part of those who have examined his work. It has been suggested that Archbishop Tenison offered Newton the Mastership of Trinity College, and that when Newton refused to accept the position Tenison said, "Why will you not? You know more divinity than all of us put together."³ We would not suggest that Newton’s theological work is as important for civilisation as his scientific work, but we cannot help thinking that perhaps Newton was a better theologian than many of his present-day critics.

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1Our selection concentrates on the works pertaining to Isaac Newton, although this is not exclusively true. We have listed in particular those books and articles, and editions of Newton's works, which we have found most helpful.

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