

THE POWER OF THE AUTHOR OF NATURE

“THE POWER OF THE AUTHOR OF NATURE”: AN EXPLORATION OF JOHN
WOODWARD’S FUSION OF NATURAL AND REVEALED RELIGION

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TITLE: “The Power of the Author of Nature”: An Exploration of John Woodward’s
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ABSTRACT:

Sir Isaac Newton's famous discovery of gravity marks the rapid advancement of science in the English seventeenth century, and a permanent shift away from the scientific methods of antiquity. Natural philosophers were beginning to look at the physical world in new and dynamic ways. However, much of this new theory conflicted with traditional theology, which was problematic for Christian followers of this 'new science'. To negotiate this conflict, a group of natural philosophers developed a new branch of science entitled physico-theology. This stream aims to prove that science does not dismiss religion, but is able to reinforce the existence of God and the truth of Biblical texts. John Woodward is a largely overlooked participant in physico-theology, but his literary works supply key information to modern readers in the understanding of this field. This study critically examines Woodward's *Natural History of the Earth* for its significant contributions to early modern science and literary techniques of this discipline. This work is indicative of an emerging scientific method that aims to accommodate both physical observation and creative thinking. I argue that Woodward's reliance on theology, while scientifically problematic, does not hinder his research, but is perversely productive by challenging him to pursue innovative hypotheses. This prominent, understudied text is remarkable for its fusion of science and theology, and for what it can illuminate about the interdependence of faith and reason in early modern science.

Thanks and Dedication:

When I initially considered the idea of writing an M.A. thesis, I imagined it to be a rather lonely endeavour. I thought about the countless hours I would spend in front of a computer screen, with my nose buried in books; a solitary struggle to find the right words to explain my ideas. However, I was delighted to discover that I never truly felt alone in this process – and that is due to some very wonderful people. I wish thank my thesis supervisor, Dr. Peter Walmsley, for his ‘above-and-beyond’ efforts to help me construct, shape and edit my work. I would also like to gratefully acknowledge my readers, Dr. Gena Zuroski-Jenkins and Dr. Cathy Grisé, for your guidance over my years at McMaster. Heartfelt thanks to my grandparents, Douglas and Doreen Bugler, for all of your encouragement and support of my education. I wish to thank my sister, Meaghan, for providing necessary diversions from my work. Many thanks to the Dalton family for all your thoughts and prayers. And finally, a warm thank you to my chief editor and enthusiast, Mark Dalton. The completion of this work and my M.A. degree would have been impossible without your support and confidence in me. Thank you for everything.

I wish to dedicate this work to my parents, Doug and Peggy Bugler. Thank you for always listening, encouraging and inspiring me in everything I do.

Introduction

John Woodward and the 'New Science'

Physical science was rapidly changing during the sixteenth and the seventeenth centuries across England and continental Europe. The foundation for all previous understandings of the natural world rested with the philosophers of antiquity, Plato and Aristotle. These philosophers focussed their efforts on logical intuition and the application of general principles to resolve questions about the Earth. Platonic and Aristotelian thought formed the basis for all scientific theory about Earth's natural laws prior to the sixteenth-century, while the Bible played a significant role as the primary source for the natural history of the Earth. By the seventeenth-century, natural historians attempted to shift away from this traditional philosophy and concentrate on observable facts and experiments in order to confirm new scientific principles. Many supporters of this 'new science' insisted on the complete separation of theology from science, claiming that spirituality and logic cannot coexist. This new method rejected the Biblical account of Earth's origins, claiming that scientific evidence will provide a more accurate understanding of the history of the Earth than found in Biblical narrative. But the 'Scientific Revolution' was anything but coherent on these matters. A select group of English theorists counter the separation of theology from science by contributing to research in what they called 'physico-theology'. This stream of science argues that by observing the configuration of the physical world, one may prove the validity of Biblical narratives and the existence of God.

The scientific discipline of physico-theology originates from Robert Boyle's interpretation and observations of the physical world. Boyle, born in Ireland in 1627, was a devoutly religious man, committed to both God's service and scientific experiment. He began meeting with the 'invisible college', later known as the Royal Society, in the mid-1640s. In 1649, he successfully erected a laboratory at his house in Stalbridge and began to show a distinct enthusiasm for experimental knowledge. Boyle resolutely believed that his scientific experiments did not undermine his religious views, but rather served to confirm the existence of God. He was concerned that the predominant Aristotelian natural philosophy posed a threat of irreligion instead of promoting a harmony between physical science and spirituality. Boyle was aware of another threat to his physico-theology: Thomas Hobbes' version of a mechanical philosophy, which opposed the fusion of logic with religion, promoting a materialistic atheism that divides science from spirituality. It became Boyle's objective to use the systematic organization of the Earth as evidence of God's divine influence over the world, proving that a theological approach to natural philosophy was productive both spiritually and scientifically. Boyle's apologetic concerns dominated his scientific research, and they encouraged his continual experimentation and interaction with natural philosophy in order to seek proof of his theories. Boyle published many works during his lifetime, and many include a fusion of both religion and natural philosophy. Upon Boyle's death, one of the codicils of Boyle's will provided for a lecture series with the objective of defending Christianity against atheists. These lectures began in 1692, the first being delivered by the scholar and divine Richard Bentley, and famously became known as the 'Boyle Lectures' (Hunter "Boyle, Robert (1627-1691)"). The

objective of these lectures was to provide an arena in which natural philosophers could consider and discuss the existence of God. The popularity of the Boyle Lectures among scholars allowed this tradition to continue frequently throughout the eighteenth and nineteenth century.¹

John Woodward, an English naturalist, participates in this alternative scientific discourse in his work *An Essay Towards an Natural History of the Earth, and Terrestrial Bodies, Especially Minerals: As Also of the Sea, Rivers, and Springs. With an Account of the Universal Deluge: And of the Effects That It Had Upon the Earth*. This text was first published in 1695; for the purpose of this study, this paper examines the third edition, published in 1723. The third edition includes Woodward's many changes to the original text, focusing on providing a more detailed argument in response to criticism of the first publication. This edition also includes Woodward's expanded criticism of other contemporary theories surrounding the Universal Deluge. Therefore, the third edition of the *Natural History* provides a more complete understanding of Woodward's argument and the public response to his controversial claims. The primary objective of Woodward's text is to examine the behaviour of minerals, soil and water bodies on Earth, in relation to the geographic location of marine fossils. Woodward attempts a structural approach to his research, by carefully documenting the location of these fossils, and personally observing the stratification of the earth. With this scientific data, Woodward intends to prove the occurrence of the Biblical universal deluge, while harmoniously creating a new theory of

¹ With only a few lectures held in the twentieth-century, the popularity of the Boyle Lectures has risen again, and since 2004, Gresham College has hosted annual lectures by modern professors of science and theology

the Earth that incorporates and explains the presence of fossils in the Earth's strata. As Woodward attempts to combine theology and science, his work documents the modern negotiation of tradition and innovation. I argue that Woodward's reliance on theology, while scientifically problematic, does not hinder his research, but is perversely productive by challenging him to pursue innovative hypotheses. This prominent, understudied text is remarkable for its fusion of science and theology, and for what it can illuminate about the interdependence of faith and reason in early modern science.

John Woodward was born on 1 May 1665 (or 1668, the exact year is unknown), in a village in Derbyshire, England. He received a formal education at a local grammar school but took an early interest in the physical world and natural history of the Earth. As a young man in 1688, Woodward began collecting natural curiosities such as fossil shells and other geological specimens. During his first apprenticeship as a linen draper, Peter Barwick, physician to King Charles II, discovered Woodward and taught him his profession. Barwick continued to assist Woodward, and helped him secure a position as a professor of physic at Gresham College in 1692. After his years as an apprentice, the University of Cambridge awarded Woodward a doctoral degree in 1695. While he was a practicing doctor, Woodward was not university educated, as were most physicians at this time. This lack of education becomes significant in his reception into the scientific community by formally educated men. Some of his contemporaries frequently criticized Woodward for attempting to theorize ideas above his class and education. Despite this response, in 1693, Woodward became a member of the Royal Society and a fellow of the Royal College of Physicians in 1703. Woodward's membership and participation within

the Royal Society was a significant achievement for an aspiring natural scientist. This membership launched Woodward into the scientific community and provided an arena in which he could propose ideas and debate theories among the leading scientists in the nation.

The Royal Society originates from a group of natural philosophers who began to meet in the mid-1640s to discuss a new philosophy of learning about the natural world through observation and experiment. The Society was officially founded in November 1660, when twelve men gathered at Gresham College and held a meeting to discuss this ‘new science’; Robert Boyle was a participant in this meeting. These men met weekly to witness experiments and discuss theories, while the Society functioned under the approval and encouragement of King Charles II. Thomas Sprat’s *History of the Royal Society* documents the early years of the society and the objectives of the natural philosophers involved in this endeavour. In his early career, Sprat was a writer and poet, and later became an ordained priest in 1661. Although he had no interest in science or natural philosophy, Sprat was nominated to become a member of the Royal Society in 1663. The society commissioned his literary talents to write a history of the organization: its objectives, goals and accomplishments. This history was primarily intended to serve as a public statement about the Royal Society in order to deflect criticism of the society’s insufficient productivity in the first four years of its existence. Sprat’s work also aims to suppress concerns that this ‘new science’ would disrupt the structure and beliefs of Restoration English culture: “[I] shall try, to assert the Advantage, and Innocence of this Work, in Respect of all Professions, and especially of Religion; and how proper, above

others, it is, for the present Temper of the Age wherein we live” (4). Sprat frames the Royal Society as a productive, beneficial endeavour and not a threat to Christian theology. This text attempts to remove any prejudices or predispositions toward the new natural history. The first part of Sprat’s *History* attempts to compare the expansion of general knowledge from the beginning of humankind with the Royal Society’s endeavour to contribute to modern knowledge. Sprat examines the era of Ancient Greece at the height of Aristotle’s academia and confirms this time to be a great influence on the general understanding of the natural world. However, Sprat argues the scholarly methods of the ancients were not as productive as they could have been:

Yet [ancient philosophy] was never able to do any great Good towards the Enlargement of Knowledge; because it rely’d on *general Terms*, which had not much Foundation in Nature, and also because they took no other Course, but that of Disputing... a thousand fine Argumentations, and Fabricks in the Mind, concerning the Nature of Body, Quantity, Motion, and the like, if they only hover a-loof, and are not squar’d to particular Matters, they may give an empty Satisfaction, but no benefit, and rather serve to swell, then fill the Soul. (16-17)

This claim that ancient knowledge was exceedingly ‘general’ in comparison with modern knowledge does not detract from the value of these general principles, but establishes modern science as having a more detailed understanding of the world. For Sprat, the general theories of ancient philosophy can serve as guidelines for members of the Royal Society, but should not confine the research of these modern scientists. The original motto of the Royal Society, ‘*Nullius in verba*’, roughly translates as ‘take nobody’s word

for it'. This motto is an indication of the attitude of the Society and the determination of the Fellows to resist the established authority of ancient philosophy ("History of the Royal Society"). The objective of the Royal Society is to extend the general knowledge base through scientific observation and experimentation in order to discover new facts about the world.

In a few Words therefore, let such Men believe, that we have no Thought of detracting from what was good in former Times: But, on the contrary, we have a mind to bestow on them a solid Praise, instead of a great, and an empty. While we are raising new Observations upon Nature, we mean not to abolish the old, which were well and judiciously establish'd by them: No more, than a King, when he makes a new Coin of his own, does presently call in that, which bears the Image of his Father; he only intends thereby to increase the current Money of his Kingdom, and still permits the one to pass, as well as the other. (Sprat 50)

Sprat suggests the Royal Society is an expansion on previous knowledge, not an endeavour to prove ancient theories as wrong or misguided. Rather, the Society shows an appreciation for the origins and history of scientific thought, but with a desire to develop the traditional scientific method into a more accurate system for understanding the physical world. It is the responsibility of the modern scientist to respect ancient philosophy and Biblical narrative, but also to endeavour to seek out a personal understanding of the natural world.

Before the Scientific Revolution, ancient philosophy was regarded as the limit of academic thought, as no other method of understanding the natural world could possibly

exceed the authority of the ancients. Sprat suggests that the ancients, such as Aristotle, were too hasty to draw conclusions without the proper proof or support for their claims (30). This imperfection of ancient philosophy encourages the Royal Society to support all new findings and theories with complete physical evidence. This concern for evidence reveals an increased awareness of the necessity of physical observations in understanding the Earth's natural laws. Sprat specifically notes Lord Francis Bacon to be the source of this new appreciation for the importance of experiment:

I shall only mention one great Man, who had the true Imagination of the whole Extent of this Enterprise, as it is now set on foot; and that is, the Lord Bacon; in whose Books there are every where scattered the best Arguments, that can be produc'd for the Defence of experimental Philosophy, and the best Directions, that are needful to promote it... The Course of it vigorous, and majestic; the Wit bold, and familiar... His Rules were admirable; yet his History not so faithful, as might have been wish'd in many Places... (Sprat 30)

Francis Bacon (1561-1626), Lord Chancellor, politician and philosopher, wrote a number of texts on natural philosophy, such as *The Advancement of Learning*, *Instauratio Magna*, and *Novum Organum*. His most significant contribution to this discipline was his framework for the scientific method, which suggests science should rely entirely on facts and observation, while disregarding any mental processing of this information. Bacon's rigid method of exhaustive research was heavily influential among the members of the Royal Society.

Woodward finds influence from many of his colleagues in the Royal Society and other prominent scientists outside the English nation. His *Essay Toward a Natural History of the Earth* incorporates theories from Thomas Burnet, William Derham, Robert Hooke, David Hume, Sir Isaac Newton, John Ray and Nicolas Steno in order to support his own theories. However, Bacon's method clearly inspires the foundational structure of Woodward's scientific research. While Woodward claims that his text steadfastly follows the Baconian method, he frequently diverts from this technique by incorporating theology and suggesting hypotheses he cannot prove with observable fact. Woodward's *Essay Toward a Natural History of the Earth* is unique for its incorporation of many innovative theories by a variety of natural philosophers of the sixteenth and seventeenth-centuries, but also for its critical interpretation of these theories. This text documents the abundance of scientific hypotheses surrounding the Earth's natural history during this time, and reveals Woodward's struggle to negotiate with these theories while contributing his own ideas to the debate.

Chapter 1

Woodward's Baconian Method

Baconian natural history requires a vigorous reliance on observation alone and a repudiation of speculative hypotheses about causes. John Woodward intends to utilize this methodology in his application of natural history to Biblical history. In the preface and first chapter of his *Essay Towards the Natural History of the Earth*, Woodward constructs the framework of his argument that the Great Flood, or Universal Deluge, actually occurred. He clearly declares the use of Baconian scientific methodology as the foremost modern approach, stating, “the World is at length convinced that Observations are the only sure Grounds whereon to build a lasting and substantial Philosophy... [which] seems to be now the common Sense of Mankind. For which Reason I shall, in the Work before me, give my self up to be guided wholly by Matter of Fact...” (Woodward 1). Woodward asserts that the Baconian method is the most precise scientific practice, which his contemporary scientific community universally agrees to be the preferred method of gaining accurate knowledge. By using Bacon’s comprehensive and exhaustive technique to prove his hypothesis, Woodward attempts to ensure that his peers understand the importance of his endeavour. He desires readers to regard his text as accurate and irrefutable truth, because he maintains Bacon’s method “to dispose and order Things” (Woodward A2v). This claim of adherence to Baconian methods becomes increasingly problematic as Woodward describes the purpose and details of this endeavour. His intention to prove the occurrence of the Universal Deluge becomes challenging, as he must account for a natural phenomenon that he is unable to witness or replicate. While

Woodward desires to use a Baconian approach of exhaustive research to prove this Biblical event, his endeavour moves beyond observations to hypotheses, to form a complete argument.

The preface of Woodward's text clearly outlines a Baconian method of observation, which he intends to apply to his subsequent research. Woodward's familiarity with Bacon's inductive methods suggests that he read Bacon's works. Bacon's most well known literary initiative was the *Great Instauration*, which was meant to contain six parts but was not finished before his death in 1626. The *Great Instauration* involves a number of Bacon's theories and ideas, but chiefly establishes the errors of previous scientific methods and suggests a new method of inquiry, previously unknown to scholars (Anderson xxix). As Fulton Anderson explains in his introduction to *The New Organon*, "the axioms or principles of this new philosophy would be statements of natural causes and natural laws derived from scientific observation and experiment, directed and interpreted according to the rules of a strict induction" (xvi). *The New Organon* was the second part of the *Great Instauration* and would likely have been the most influential text upon Woodward's methods as it specifically outlines Bacon's innovative scientific philosophy. In his analysis of Bacon's work, Anderson states, "Of the six divisions of his instauration Bacon considered this the most important of all, and there can be no doubt that he looked upon the *New Organon* as likely to be in effect the most consequential of all the literary works produced by him in the promotion of a new learning founded on a new type of science" (xxxiii). This chapter of the larger Instauration is pivotal in

understanding Bacon's desire to eliminate scientific error and the natural philosophy he intends to teach.

The preface to the *New Organon* succinctly summarizes the objective of this text. Bacon clarifies that his interest lies in the knowledge to be gained from the physical world through the senses.

Now my method, though hard to practice, is easy to explain; and it is this. I propose to establish progressive stages of certainty. The evidence of the sense, helped and guarded by a certain process of correction, I retain. But the mental operation which follows the act of sense I for the most part reject; and instead of it I open and lay out a new and certain path for the mind to proceed in, starting directly from the simple sensuous perception. (33-34)

Bacon clearly states that his scientific process is extremely mechanical, slowly building upon observations to establish fact. Bacon's influence upon Woodward's *Natural History of the Earth* is clear. The first chapter of Woodward's text reflects his understanding of Baconian methodology: "From a long Train of Experience the World is at length convinced that Observations are the only sure Grounds whereon to build a lasting and substantial philosophy. All Partyes are so far agreed upon this Matter, that it seems to be now the common Sense of Mankind" (1). This statement proves the resonance of Bacon's methods in the scientific world and their strong impact on the future of scientific research. The Baconian theory was so popular among seventeenth-century scientists that it became understood as foundational doctrine for scientific study.

While focusing his method on the need for exhaustive research, Bacon specifically rejects mental processing of physical observations. The process of thinking about a question or idea is a key component of previous philosophical doctrines, such as Aristotelian logic and Platonic natural theology. These systems of thought provided the foundation for science and philosophy before Bacon. He is extremely critical of these schools of philosophy and specifically addresses this idea in the *New Organon*, Book One of his Aphorisms:

XCVI

We have as yet no natural philosophy that is pure; all is tainted and corrupted: in Aristotle's school by logic; in Plato's by natural theology; in the second school of Platonists, such as Proclus and others, by mathematics, which ought only to give definiteness to natural philosophy, not to generate or give it birth. From natural philosophy pure and unmixed, better things are to be expected. (93)

In this aphorism, Bacon distinguishes his idea of natural philosophy from logic and theology. He believes these concepts only serve to cloud the purity of observation. This was a novel and modern approach to scientific study as Bacon chose to ignore the methodologies of earlier thinkers. Interestingly, Bacon titles his statements as aphorisms, or general truths and he does not provide his theories without any explanation or evidence. Therefore, by titling his idea aphorisms, he is proposing that his methods and ideas are factual. The text also states each aphorism individually, physically separating the concepts by roman numerals. This division distinctly indicates that there are differences between the individual points and that each may stand alone as a significant

contribution to natural philosophy. Woodward's entries in *A Natural History* follow a similar separation pattern by dividing his theories into parts, which allows reader to consider the ideas individually but also unifies the entire work. The first aphorism listed in book one of Bacon's *New Organon* states, "Man, being the servant and interpreter of Nature, can do and understand so much and so much only as he has observed in fact or in thought of the course of nature. Beyond this he neither knows anything nor can do anything" (39). This idea restricts an observer from mentally processing any findings and thus eliminates theories, guesswork and hypotheses from science. Bacon's practice of exhaustively documenting all observations and ignoring mental contemplation, while innovative, does not easily produce new scientific discoveries. Understanding Bacon's principles of this 'new science' significantly affects our reading of Woodward's research.

As Jonathan Smith reminds us, the principles of Baconian induction include, "pure objectivity, absolute certainty, avoidance of hypotheses, gradually widening generalization, [and] systematic elimination of all possible explanations" (4). Woodward's essay violates this inductive process with speculation, imagination and the use of a predetermined hypothesis of the Deluge's reality. The preface to Woodward's *Natural History of the Earth* assures the reader that he will only draw conclusions from physical observations of the Earth. However, he frequently relies on Biblical texts to form a foundation for his deductions. Woodward's Christian background functions as an exterior influence on this text. Had he observed the same natural phenomena as a scientist unfamiliar with Christian doctrine, it is unlikely that he would draw the same conclusions. The influence of Christian principles on Woodward's work is evident as his content

frequently incorporates passages from the Old Testament. He regards these texts as historical evidence and he uses them as factual support while discussing his physical observations of the world. Woodward possesses previous knowledge of Biblical texts as he is from a Christian background. The inclusion of these passages reveals that Woodward is drawing connections between his immediate observations and his past knowledge. Therefore, the incorporation of this doctrine into his work subverts Baconian methodology because it is not something Woodward physically observes, but comes from his previous knowledge of Christianity. Bacon maintains that one must approach science without any preconceived notions or theories in order to unveil scientific truth. While Woodward does occasionally consider other explanations of his findings, he most frequently attempts to fit his observations into the Creation narrative and his theoretical model of the Universal Deluge. As Woodward admits, he is only able to conduct his personal observations in England. In order to prove the occurrence of the Biblical event, it is necessary that Woodward's findings are consistent around the world, therefore ensuring the flood was 'universal' and not a localized event. Upon considering this requirement, Woodward states,

But to supply, as far as possible, that Defect, I made Application to Persons who had already travelled, and I knew were of such Integrity, that they would not impose uncertain or false Relations upon me: as also of so much Curiosity as to be likely to give me some tolerable Insight into the Condition of these Things in Foreign Regions. I likewise drew up a List of Queries upon this Subject; which I dispatch'd into all Parts of the World, far and near, wherever either I my self or

any of my Acquaintance, had any Friend resident to transmit those Queries unto.

(6)

This statement reveals that Woodward anticipates that his hypothesis of the Deluge's reality will yield a successful result and confirm his theory. If Woodward did not attempt to prove this specific event, it would not have been immediately necessary for him to send others out of England to confirm the universality of his findings. It is also problematic that Woodward relies upon the memories and observations of others who have travelled to other regions of the globe. He is working under the presumption that the integrity of those he selects to report their findings will prevent any scientific error or incorrect assumptions from occurring. Therefore, Woodward's desire to prove the occurrence of the Universal Deluge guides his scientific process away from Bacon's methodology.

The confirmation of the Deluge's reality would support Woodward's teleological argument, directly confirming God's existence. The ability to prove the accuracy of this Biblical event would also lead toward a greater understanding of God's nature, verifying that God purposefully flooded the Earth to express His displeasure with the sinfulness of humanity. The desire to understand the Nature of God is a common influence among many scientific and philosophical writers of the late seventeenth and eighteenth-centuries. David Hume's *Dialogues Concerning Natural Religion*, written in the mid eighteenth-century, focuses on a fictional dialogue between three men, each representing one of the three most common approaches toward understanding divine nature. The dialogue begins with a discussion of how guardians should raise children or pupils in order to provide the best education and in what order they should teach logic, ethics, physics, and religion.

The conversation quickly turns to a discussion about ‘natural religion’ and its requirements for understanding God. Pamphilus, the narrator of the story and pupil of Cleanthes, frames the objective of this debate for the reader. He declares God’s existence as an obvious truth, “but in treating of this obvious and important truth; what obscure questions occur, concerning the NATURE of that divine Being; his attributes, his decrees, his plans of providence?... Concerning these, human reason has not reached any certain determination” (Hume 9). Pamphilus introduces the reader to three philosophers, Demea, Cleanthes and Philo whom attempt to reach a conclusion on the best approach to understanding the Nature of God. Demea represents the most traditional approach to understanding God as he asserts that faith and reason are mutually exclusive perceptions. As he declares faith is independent of cognitive logic or reason, one may only attempt to understand God through revealed religion. Demea argues that humans should be in humble awe of God and not question His presence or will.

Finite, weak and blind creatures, we ought to humble ourselves in his august presence; and conscious of our frailties, adore in silence his infinite perfections, which eye hath not seen, ear hath not heard, neither hath it entered into the heart of man to conceive. They are covered in a deep cloud from human curiosity: It is this profaneness to attempt penetrating thro’ these sacred obscurities: And next to the impiety of denying his existence, is the temerity of prying into his nature and essence, decrees and attributes. (Hume 42)

This view heavily emphasizes the importance of the Bible in producing religious faith. Demea presents the human relationship with God as solely worshipful, arguing that

people should be aware of His perfection, although they are unable to understand Him. This view represents God as purposefully deceptive, hiding divine knowledge from people, and states that any attempt to understand the Nature of God is wrong and disrespectful. Demea maintains that since people cannot physically sense God's presence, they must rely on revealed religion to better understand the human relationship with God.

Philo, although he does not deny God's existence, represents the sceptic argument that humans do not possess the ability to understand divine nature at all. He argues,

But when we look beyond human affairs and the properties of the surrounding bodies: When we carry our speculations into the two eternities, before and after the present state of things; into the creation and formation of the universe; the existence and properties of spirits; the powers and operations of one universal Spirit, existing and beginning and without end; omnipotent, omniscient, immutable, infinite, and incomprehensible: We must be far removed from the smallest tendency to scepticism not to be apprehensive, that we have here got quite beyond the reach of our faculties. (Hume 25-26)

Philo maintains that people are not capable of making assumptions or drawing conclusions about God, dismissing both fideism and teleology. This approach easily accompanies Bacon's methodology and theory that one may only learn as much as the physical senses reveal. Philo specifically describes God as infinite in all forms, drawing a comparison with the mortality of humans. This statement suggests people should recognize themselves as vastly inferior to God and should worship His greatness. This approach supports a distant relationship between humans and God. Philo's argument

relies on the belief that humans do not possess the mental capacity to understand such a large, infinite concept. Cleanthes's opposing argument is most similar to Woodward's endeavour. He believes that although humans cannot physically sense God, His existence is evident through the physical design of the Earth and universe. Cleanthes argues against the sceptical approach and insists that humankind is capable of understanding God's nature through scientifically proven phenomena:

Where-ever evidence discovers itself, you adhere to it, notwithstanding your pretended scepticism; and I can observe, too, some of your sect to be as decisive as those who make greater professions of certainty and assurance. In reality, would not a man be ridiculous, who pretended to reject Newton's explication of the wonderful phenomenon of the rainbow, because that explication gives a minute anatomy of the rays of light; a subject forsooth, too refined for human comprehension? (Hume 28-29)

Cleanthes maintains that this form of scepticism only hinders the expansion of knowledge, not religion. Instead, Cleanthes suggests that religion and science, faith and reason, benefit from mutual consideration. He argues that one is able to understand God's nature through observing the environment. Cleanthes specifically points to the perfection of the Earth and indicates that every system and part of the world functions so mechanically and accurately that the only explanation for this perfect design is divine creation (Hume 47). Furthermore, Cleanthes argues that God's design of the Earth resembles, although it exceeds, "the productions of human contrivance; of human design, thought, wisdom and intelligence. Since therefore the effects resemble each other, we are

led to infer, by all the rules of analogy, that the causes also resemble; and that the Author of Nature is somewhat similar to the mind of man; though possessed of much larger faculties” (Hume 48). The ‘argument from design’ approach theoretically brings humans and God closer together, instead of separating them like the teleological and sceptical methods. Cleanthes argues that through the natural world, God provides His people with physical evidence of His existence. This immediate presence lessens the distance between human and God as divine force surrounds people at all times. While Cleanthes admits that God possesses greater power than humans, he parallels His design process with human contrivance. The design of the Earth proves to be so logical that it resembles the production of human design. Cleanthes’ conclusion declares the similarity of God’s nature to human nature and proclaims that this logical design allows humans to understand God’s nature. Of the three most common approaches to understanding God’s nature described in Hume’s text, the design argument is the most innovative and controversial. Woodward, like many other naturalist observers, takes up the ‘argument from design’ that Hume describes in his dialogue. Woodward pushes the design argument beyond pure observation of the natural world by combining observation with scientific research, hypotheses and speculation.

Hume’s text reveals the significance of this debate within the scientific and philosophical realm. *Dialogues Concerning Natural Religion* specifically mentions the theories of prominent individuals in order to draw attention to the arguable divide between science, philosophy and religion. Hume was obviously very familiar with current scientific concepts as his three characters discuss the thoughts of Galileo, John Locke and

many other significant theorists. It is clear that Hume was also aware of Bacon's attitude toward philosophy: "Don't you remember, said Philo, the excellent saying of Lord Bacon on this head? That a little philosophy, replied Cleanthes, makes a man an Atheist: A great deal converts him to religion" (36). This statement shows how closely related the disciplines of philosophy, religion and science were regarded, but that small differences in theoretical approach yield vastly different opinions. Woodward's *Natural History of the Earth* is innovative because he is attempting to combine all three of these common approaches in order to gain a full understanding of God. While he is tentative about making assumptions about God's divine will, he focuses on using both physical observations and revealed religion to prove the occurrence of the Universal Deluge and to reassert the existence of God.

While Woodward claims to base his arguments entirely upon fact and observation, he inadvertently diverges from this objective. While contemplating his research methods, Woodward states, "I enter'd [my observations] carefully into a Journal, which I carry'd along with me for that Purpose... I noted whatever I found to be memorable in each particular Pit, Quarry, or Mine: and 'tis out of these Notes that my Observations are compiled" (4). Instead of considering and including all of his findings, which is a key component of Baconian methodology, Woodward chooses to record only what he believes to be memorable, or important in proving his hypothesis. This selective process reveals his desire to find facts and results that support the idea of the occurrence of the Deluge. The exclusion of particular information violates the methodological necessity of including all information available, as Bacon states, "if in any statement there be anything

doubtful or questionable, I would by no means have it suppressed or passed in silence, but plainly and perspicuously set down by way of note or admonition” (282). Bacon’s desire to include *all* found data would find Woodward’s finalized essay to be problematic. The *Natural History of the Earth* essay selects and explains particular data to the reader, and Woodward uses manipulative language to convince the reader of the validity of his claims. He continually attempts to press upon the reader that he derives his conclusions only from proven and observed facts, “which indeed are not built upon any Niceties, or solitary and uncommon Appearances, but on the most simple and obvious Circumstances of these terrestrial Bodies” (7). This persuasive writing attempts to convince the reader that his conclusions are natural and easily apparent. While he encourages readers to think for themselves, he ultimately wishes for a universal agreement with his own theories.

As it is difficult for any scientific essay to include all data while still maintaining a distinct argument, this brings the reader to question whether following Bacon’s methodology is unrealistic or unfocused. Woodward’s text also becomes problematic because his approach toward his data and sources. He chooses to regard Biblical texts as historical records, treating them as equally significant proof in comparison with other scientific writing or findings. This is not a common technique among scientific publications of the seventeenth- and eighteenth-century, as they typically offered a scientific attack on learned authority, such as Moses’ flood narrative. Woodward explains his inclusion of Biblical texts in his preface, stating; “And for Moses, he having given an Account of some Things which I here treat of, I was bound to allow him the same Plea that I do other Writers, and to consider what he hath deliver’d. In order to this I set aside

every Thing that might byass my Mind, over-awe, or mislead me in the Scrutiny: and therefore have Regard to him here only as an Historian” (A5R). The inclusion of Old Testament religious stories and doctrine problematizes Woodward’s claim that his text adheres to Bacon’s methods. Woodward’s bias towards Christianity is evident, as he does not consider texts of other religious doctrines and begins this project only to prove the occurrence of a Biblical event. The inclusion of Christian narratives reveals Woodward is starting out with speculative ideas instead of following Bacon’s mechanical, objective methodology. Thus, it is possible to conclude that Woodward’s science, as Smith suggests, anticipates a nineteenth-century scientific framework in which science “requires hypothesis and deduction, the genius of an individual creative mind willing to guess, to imagine, to leap to conclusions” (4). While Woodward’s ‘leap’ to hypothesizing the validity of the Deluge is unusual, it challenges him to discover innovative facts and theories.

The primary objective of *The Natural History of the Earth* is to prove the occurrence of the Universal Deluge, more commonly known as the Great Flood. The Biblical story of the Deluge appears in Genesis, the first book of the Old Testament. Genesis states that the flooding of the entire Earth was a result of God’s frustration with the lawlessness of humankind. God desires to destroy all life on Earth except for Noah, his family and two of each animal species (*King James Bible*, Genesis 6.5-13). God’s omnipotence allows Him control of the entire world and so He purposefully brings forth a rain that lasts forty days and forty nights in order to submerge all dry land on Earth. The water eventually recedes, dry land emerges, and the Earth repopulates with all of the

species saved in Noah's ark (Genesis 7.11-24). Unlike the New Testament 'loving God', this narrative presents a vengeful God who would take action against sinfulness. After the flood recedes, God vows never to destroy the Earth again:

And the LORD smelled a sweet savour; and the LORD said in his heart, I will not again curse the ground any more for man's sake; for the imagination of man's heart is evil from his youth; neither will I again smite any more every thing living, as I have done. While the earth remaineth, seedtime and harvest, and cold and heat, and summer and winter, and day and night shall not cease. (Genesis 8.21-22)

Although He vows never to harm the Earth again, the action of purposefully drowning all the people on Earth, presents God as a threatening figure. Woodward frames his research around this narrative, looking for physical evidence that suggests all earthly matter was swirling within a vast solution before settling into the present state of the Earth. Genesis is the primary text Woodward focuses on, but he also includes excerpts from Job, Matthew and First Corinthians. These Biblical texts become more than a foundation for Woodward's work; they also become part of the evidence. Quotations and passages from the Bible frequently appear throughout *The Natural History* with the purpose of supporting the validity of the Deluge.

Woodward focuses his argument on the consistency of the globe by examining natural laws, such as gravity and strata formation. God's vow that the Earth will continue in a perfect balance acts as foundational evidence for Woodward's argument that the world exists as an equilibrium, which he intends to support with physical evidence (Genesis 8.22). Woodward maintains that natural laws provide organization and balance

to the entropy of the world, which proves the existence of God. Woodward uses a passage from Job as evidence in his argument that divine power is the primary force of organization in the world:

Or was the Universe left to its own Conduct and Management: the whole Mass of created Matter to its proper Disposition and Tendency: were there no restraint of Bounds to the Earth no Curb to the Ocean: was there not One who had *set Bars and Doors to it, and said hitherto shalt thou come, but no farther, and here shall thy proud Waves be staid**; then indeed might we well expect such Vicissitudes and Confusions of Things: such Depredations, and Changes of Sea and Land.

**Job xxxviii. 10,11. (Woodward 64)*

This line from Job indicates that God personally decides the organization of all earthly matter. Woodward specifically notes that without this guiding force, the world would descend into mass chaos and entropy. Therefore, God's presence is necessary to the continuation of the human existence. It is interesting that while Woodward focuses on this orderliness, the Universal Deluge defies natural law. Christians consider the Deluge to be a miraculous event and although proving its validity is Woodward's main objective, his observations of the consistency of the world do not seamlessly connect with the occurrence of a miracle that does not adhere to natural laws. Hume's *Enquiry Concerning Human Understanding* includes a section titled 'Of Miracles' that discusses how the concept of miraculous events functions in society. Hume debates the validity of miracles and the ability of eyewitnesses to prove such events. He argues, "A miracle is a violation of the laws of nature; and as a firm and unalterable experience has established these laws,

the proof against a miracle, from the very nature of the fact, is as entire as any argument from experience can possibly be imagined” (‘Of Miracles’ X.I). The miracle of the Universal Deluge is an interruption of God’s constant care of the Earth. Woodward attempts to prove God’s existence by observing the present consistency of Earthly matter and natural law around the globe. However, Woodward argues that fossils are evidence that the Earth was not always consistent and experienced a time of mass chaos.

Difficulty arises in Woodward’s endeavour to prove the Universal Deluge because he cannot witness or replicate the event. Instead, he relies on physical evidence, such as fossils and strata formation, and eyewitnesses to the event to prove the flood. Hume cautions against the use of eyewitnesses as the human memory may be unreliable. He states, “The contrariety of evidence, in the present case, may be derived from several different causes; from the opposition of contrary testimony; from the character or number of witnesses; from the manner of their delivering their testimony; or from the union of all these circumstances” (‘Of Miracles’ X.I). The only eyewitnesses that Woodward has access to are Biblical testimonies from men like Moses. While Woodward proclaims he intends to approach Moses’ statements as purely historical evidence, Hume argues that this approach is problematic because Moses inherently links to religion:

But if the spirit of religion join itself to the love of wonder, there is an end of common sense; and human testimony, in these circumstances, loses all pretensions to authority. A religionist may be an enthusiast, and imagine he sees what has no reality: he may know his narrative to be false, and yet persevere in it, with the best

intentions in the world, for the sake of promoting so holy a cause ('Of Miracles' X.II).

These inconsistencies in Woodward's text indicate why his work has received so little study in modern academia. However, despite these problematic contradictions, Woodward continues to attempt to create a method of fusing Biblical texts with physical evidence in order to establish a universal understanding of the Earth's natural history.

While Woodward maintains a firm belief in the legitimacy of his hypothesis, he is not ignorant of the fact that some of his readers may find his claims strange. He states the purpose of his work is "...to assert the Superintendence and Agency of Providence in the natural World: as also to evince the Fidelity and Exactness of the Mosaic Narrative of the Creation and of the Deluge. Which 'tis not improbable but some may be apt to stumble at, and think strange that, in a Physical Discourse as this is, I should intermeddle with Matters of that Kind" (A5R). Woodward addresses this issue of validity in the preface of his text to avoid readers' immediate dismissal of his theories. Woodward's statement reveals that he is self-conscious about his methodological departures and is unsure whether readers will consider his theories as serious endeavours. He contemplates his audience, proponents and critics of the 'new science', and is aware that some people may find this fusion of physical science and religion to be problematic. This careful consideration reveals Woodward's knowledge of the cultural discourse and struggle between ancient and modern authority.

The great effort to deny physical science and theology as mutually exclusive disciplines was not limited to Woodward's research. Robert Boyle endeavoured to

combine the two disciplines and reveal how both science and religion would benefit from collective study. His work functioned as an inspiration for Woodward's studies. Boyle's remarkable approach continued after his death through the participation of other natural philosophers in the Boyle Lectures. These events were a series of lectures designed to defend the Christian religion against atheists and others groups by using the environment to prove God's existence (Hunter, 'Boyle, Robert (1627-1691)'). Many prominent natural philosophers participated in these lectures shortly after Boyle's death in 1691, most notably Richard Bentley, William Derham and Samuel Clarke. Derham's 1713 text, *Physico-theology: Or, a Demonstration of the being and Attributes of God, from his Works of Creation*, picks up from Boyle's desire to fuse science and religion. Physico-theology, as Derham describes, strives "to improve this occasion in the Demonstration of the Being and Attributes of an infinitely wise and powerful Creator, from a cursory survey of the Works of Creation, or (as often called) of Nature" (3). Hume's 'argument of design' found in his *Dialogues Concerning Natural Religion* parallels Derham's definition of physico-theology. This approach endeavours to prove both the existence of God and discover some of His attributes or personal nature. The exploration of physico-theology by many natural philosophers reveals that this theory became a trend in late seventeenth-century and early eighteenth-century science. Although the development of this theory rests on finding God's presence in the natural world, many of the arguments and hypotheses differ slightly among the physico-theologians. These discrepancies occur because it is a relatively novel approach to understanding the connection between God and nature. This innovation spurred debate among natural philosophers, within academic

arenas like the Boyle Lectures and the Royal Society, and with external groups such as atheists and traditional Christians. The result of this debate was the production of literature for and against the practice of physico-theology. Woodward's *Natural History of the Earth* participates in this novel discourse and contributes new ideas to this modern theory.

Upon reviewing his own theories, Woodward reflects, "it will perhaps, at first Sight, seem very strange, and almost shock an ordinary Reader to find me asserting, as I do, that the whole Terrestrial Globe was taken all to Pieces and dissolved at the Deluge" (A2v). This statement addresses the conventional separation of science from religion and proposes that, although the reader may find it initially shocking, the fusion of these two disciplines will reveal new knowledge about the physical world. Woodward explains that his purpose of introducing his hypothesis before explaining his scientific findings is so "that each Reader may the better inform himself, not only of what Sort my present Observations are, but see in what Manner also and with what kind of Accuracy they were made... whereby he may be enabled to judge how far they may be rely'd upon, and what Measure of Assent the propositions which I draw from them may claim" (2). While Woodward retains his right to assess scientific and religious texts in a critical manner, he understands that his audience reserves the same right to observe and analyze his essay with the same critical approach. Woodward encourages his readers to engage with his theories and draw their own conclusions about his ideas. This desire to interact with his audience reveals that he is accustomed to criticism and debate as a participant in the scientific community and cultural discourse. Woodward does not wish to lecture his

readers but instead encourages them to engage with this pedagogical framework. However, Woodward's text also suggests he is confident that his arguments and proof will "not fail of doing their Part in convincing [the reader] still more of the Truth and Certainty of this Matter" (Woodward A3v). While Woodward's preface reveals a particular bias towards proving the existence of the Deluge, he withdraws to the Baconian objective methodology to convince his audience of the validity of his theories. This contradiction is problematic and initiates a questioning of the legitimacy of Woodward's scientific and literary methods. He admits that his arguments may not seem fully formed but intends to forewarn his audience that this essay is merely part of a "scheme of a larger Design" (Woodward 2). The objective of creating a larger, comprehensive work is similar to Bacon's promise of future works at the end of *The New Organon*. Woodward implores his readers to understand his theories to be part of a very large endeavour and that "proposing to draw a considerable Number of Materials into so narrow a Compass that they might all be contain'd in this small Volume, [he is] obliged to be very brief and concise" (A2R). In this manner, Woodward protects his theories from immediate dismissal. While he attempts to explain his ideas completely, he also makes it clear that any uncertainty, vagueness or ambiguity is not due to any problems with his research, but to the confinement of his writing to a small volume. Woodward approaches this introduction to his scientific endeavour as a space in which he can explain the purpose of his studies to his audience. His preface and introduction primarily function to convince the reader of the exactness of Woodward's research and purposefully attempt to

encourage the reader to remain open to this fusion of scientific data and religious doctrine.

Chapter 2

Fossils

An Essay towards a Natural History of the Earth primarily engages with a scientific examination of fossils and observations on their geographic locations in the earth. Woodward questions the locations of marine fossil deposits, mainly of shells and aquatic creatures, as he finds many of them in places entirely remote from any body of water. He combines these questions with his theory of the Universal Deluge, suggesting the Biblical flood is responsible for the non-coastal locations of marine fossils. In Part I of his essay, Woodward addresses established theories that attempt to explain the terrestrial isolation of these fossils. The earlier theories he chooses to examine are:

1. "... these Shells were fetch'd from Sea by ancient inhabitants of those Countries where they are now found; who after they had used the included Fishes for Food, flinging forth the Shells, many of them became petrified..." (37).
2. "... they were only Reliques of some former great Inundations of the Sea; which... bore these Bodies out upon the Earth along with it: but returning at length more leisurely and calmly back again, it left them all behind" (38).
3. "... the Sea frequently flitted and changed its Place... [and] left these Shells there as Marks of its ancient Bounds and Seat" (38-39).
4. "... there were indeed some who believed these to be Remains of the General Deluge... these last assuredly were in the right; but the far greater Part of them rather *asserted* than *proved* this..." (39).

Woodward declares that none of these theorists could prove their hypotheses with scientific observation or concrete evidence, which renders them irrelevant. Although he specifically lists each of these theories, Woodward does not attribute an author to the individual ideas. This may be an indication that these were well-known theorists and common fossil theories. Woodward's audience may have easily been able to link these theories to their creators without his direction. Some of these ideas may also have been folklore, without any known original theorist. Upon comparing these various hypotheses, Woodward finds it problematic that the ideas contradict each other, and thus "each could demolish the others Work with Ease enough, but not a Man of them tolerably defend his own; which was sure never to outstand the first assault that was made" (40). Even the theory of a general deluge, which Woodward supports as the *most* correct hypothesis, cannot be a superior theory over the others because it lacks observable evidence. Without physical proof, Woodward argues, these hypotheses are merely suppositions and are not yet viable within scientific discourse. The inclusion of these theories reveals Woodward's knowledge of current speculation surrounding fossil locations and their origins. By addressing these hypotheses, he acknowledges that his own essay does not propose the only theory of marine fossil relocation. Instead, his work is participating in a greater cultural discourse.

At the time of Woodward's writing, many various fossil theories appeared within modern scientific publications and there also remained many ancient theories that provided popular explanations for the strange natural objects. The most widely accepted theory of fossil origin returns to Aristotle's hypothesis that they grew and formed within

the Earth, and that a “shaping force, or ‘extraordinary Plastick virtue,’ could thus create stones that looked like living beings but were not” (Waggoner, *Robert Hooke 1635-1703*). The works of Nicolas Steno, John Ray and Robert Hooke offer some of the most advanced fossil theories of the seventeenth-century that question and contradict ancient theories, such as Aristotle’s conclusion. The hypotheses of Steno, Ray and Hooke provide a cultural framework that helps to clarify Woodward’s understanding and formation of his own fossil theory.

Nicolas Steno’s scientific career contributed a number of significant theories to modern geology. He focussed his scientific endeavours on the formation of strata layers in the Earth and the fossils they contain. In 1665, his work attracted the interest of the Grand Duke of Tuscany, Ferdinand II, who was a scientific patron. He allotted Steno to a hospital post that allowed ample time for his research (Waggoner, *Nicolas Steno 1638-1686*). Steno would have been familiar with the common understandings of fossils when he first began his studies. In addition to Aristotle’s theory, the ancient Roman author Pliny the Elder suggested a different hypothesis for how these objects came to be found within the Earth. Pliny the Elder specifically discussed *glossopetrae* or ‘tongue stones’ he found in the earth. He believed that the *glossopetrae* became embedded within rocks and soil after they fell from the sky or moon. In October of 1666, Ferdinand II sent Steno the head of a large shark caught by local fishermen. Upon comparing living shark teeth to fossilized *glossopetrae* found in the Earth, Steno noticed a physical resemblance. He concluded that these fossilized objects resembled shark teeth because they had directly come from the mouths of once-living sharks. Furthermore, he argues that these shark

teeth initially were buried in mud or sand, which had turned to solid earth over time (Waggoner, *Nicolas Steno 1638-1686*). This theory explains how the fossils reside deep *within* the earth instead of remaining near the surface. Similar to Woodward's gravitational strata theories, Steno considered the idea that all solid land was once fluid or dissolved within a fluid. Steno concludes in his *Prodromus* that,

The strata of the earth are due to the deposits of a fluid.

1. Because the comminuted matter of the strata could not have been reduced to that form unless, having been mixed with some fluid and then falling from its own weight, it had been spread out by the movement of the same superincumbent fluid.
2. Because the larger bodies contained in these same strata obey, for the most part, the laws of gravity...
3. Because the comminuted matter of the strata has so adjusted itself to the bodies contained in it that it has not only filled all the smallest cavities of the contained body, but has also expressed the smoothness and lustre of the body... (227)

This theory forms the foundation of Steno's Principle of Horizontality, which declares that rock layers form horizontally, in a process over time. He also notes that any disruptions to this pattern occur after the initial formation of the layers.

... it is certain that at the time when any given stratum was being produced its lower surface, as also its lateral surfaces, corresponded to the surfaces of the lower substance and lateral substances, but that the upper surface was parallel to the

horizon, so far as possible; and that all strata, therefore, except the lowest, were bounded by two planes parallel to the horizon. Hence it follows that strata either perpendicular to the horizon or inclined toward it, were at one time parallel to the horizon. (Steno 230)

This principle presents the formation of the Earth's layers as even and constant. Steno's assumption that all rocks and solid earth were once fluid matter complements Woodward's concept of the swirling Universal Deluge. Both theorists agree that particles suspended in a solution would settle gravitationally and create the visible horizontal layers in the strata.

Steno's Law of Superposition builds upon his first principle of original horizontality. Steno argues that the layers of rock arrange according to time sequence, instead of separation by gravitational particle weight. This theory presents the lowest strata layers to be the oldest, while the surface layers are the newest. He states, "At the time when one of the upper strata was being formed, the lower stratum had already gained the consistency of a solid... At the time when any given stratum was being formed, all the matter resting upon it was fluid, and, therefore, at the time when the lowest stratum was being formed, none of the upper strata existed" (Steno 230). The Law of Superposition is Steno's most significant and lasting contribution to geological studies. He does admit that an exception to this law exists if the Earth is disturbed after the initial layering. These disruptions include volcano eruption, earthquakes and other natural phenomena. Such disruptions may result in the formation of mountains, canyons and general unevenness of the Earth's surface (Steno 231). While these anomalies complicate the analysis of the

strata, such disruptions leave physical evidence in the Earth, thus providing researchers more insight into the continual motion and modification of the Earth's crust (Waggoner, *Nicolas Steno 1638-1686*).

Steno's understanding of strata formation is foundational in his fossil theory. His theory that the Earth's layers were initially fluid suggests that objects could embed in layers before they solidified.

If a solid body is enclosed on all sides by another solid body, of the two bodies that one first became hard which, in the mutual contact, expresses on its own surface the properties of the other surface. Hence it follows:

That in the case of those solids, whether of earth, or rock, which enclose on all sides and contain crystals, selenites, marcasites, plants and their parts, bones and the shells of animals, and other bodies of this kind which are possessed of a smooth surface, these same bodies had already become hard at the time when the matter of the earth and rock not produce the bodies contained in them, but they did not even exist as such when those bodies were produced in them. (Steno 218)

Therefore, a fluid substance, such as mud, would form around a solid object immersed within itself, such as a bone or shell. The conformation of the host rock to the shape of the object proves that the object was a solid before the surrounding sediment became solid. This theory proves that fossilized objects existed before the formation of the sediment layer in which they are found.

Initially, the Law of Superposition seems to discredit Woodward's Universal Deluge theory, because he theorizes the layering of the strata is due to gravity and not the

progressive building of layers over time. However, it is necessary to remember that “Steno’s law is a statement of relative time, not absolute time: two rock layers, in principle, could have formed millions of years apart or a few hours or days apart. Steno himself saw no difficulty in attributing the formation of most rocks to the flood mentioned in the Bible” (Waggoner, *Nicolas Steno 1638-1686*). While Steno concludes the lowest strata layers to be the oldest, this gives no indication of the length of time necessary for individual rock layers to form. While the lowest layer is temporally the first to settle, it could have been minutes, days or centuries before the next layer formed. Thus, Woodward’s Universal Deluge remains credible even considering Steno’s theory.

John Ray was one of the first scientists whose fossil theory led to the conclusion that the Earth may be older than the Bible indicates. Similar to Woodward and Steno, Ray’s research agrees that fossils are the remains of once-living creatures. As a devout Christian, Ray was a supporter of natural theology. In *Physico-theology*, Derham specifically mentions Ray as a significant contributor to natural theology and inspiration for others’ work in this discipline, although Ray does not necessarily agree with all ideas or conclusions published in the name of natural theology, including Woodward’s work. He believes in the occurrence of a universal deluge and agrees that some fossils may have formed during an event similar to the Great Flood. However, he also maintains that many of the fossils found in the Earth are not a result of this singular event. Ray theorizes that during the Earth’s initial creation, one singular ocean covered the entire surface of the Earth, which had slowly receded to expose dry land. He argues that this measured process left the fossilized objects behind as remnants of this once present ocean, opposing

Woodward's theory that a flood forcefully pushed the fossils ashore. The Universal Deluge would have had to move water around the globe very quickly in order to completely cover and then re-expose the Earth in a span of forty days. While Woodward believes the quick relapse of water would leave aquatic fossils behind on dry land, Ray disagrees.

... I doe not see how this disposition of beds can consist with Dr. Woodward's hypothesis of the sediments of the generall deluge; for so there could be no repetition of the same order of the Beds. I have formerly objected against the Generall Deluge bringing in shels the causes that the Scripture assigns that Deluge viz. a rain of 40 days, and the breaking up the fountains of the great Deep or bringing subterraneous waters upon ye superficies of the Earth; and not any inundation of the Sea at all: which causes were more likely to carry down shels to the sea than to bring any up; especially so far as into ye midst of great Continents.
(266)

Ray's argument questions whether fast moving waters could possibly leave fossils behind or not. He chooses to believe that fast currents would sweep aquatic species away from the land and carry them into the deep waters of the ocean. Ray argues that a slower recession of water, such as the initial exposure of dry land during Creation, would allow the aquatic creatures to remain behind on dry land and turn into fossils. Ray notices that the location of fossilized objects within rock and sediment also troubles Woodward's theory. In one of his letters, Ray challenges Woodward's deluge theory stating, "... there is little likelihood of demonstrating how the Universall Deluge could lodge these bodies

so deep in ye bowels of ye mountains and rock; yet it would be a great satisfaction to me to see it well made out” (Ray 254). The critique of Woodward’s research and hypotheses reveal a discourse among physico-theologians. Although these theorists are arguing towards the same general ideas, there are many discrepancies within their individual notions. Arguments and challenges reveal weaknesses in theories and therefore, push natural theologians to definitively prove their hypotheses.

While conducting research on fossils, Ray encounters some fossils that obviously link to extant creatures, but he also found some that do not resemble any living organisms. Ray’s inability to connect these fossils to extant creatures led him to the conclusion that modern scientists remained very ignorant of the full range of living species in the world. He determined that the fossilized creatures he observed might be presently living in unexplored places around the globe. Later in his career, Ray began to consider what else these strange fossils might indicate. In a letter to the Welsh naturalist Edward Lhwyd, Ray writes,

Yet on the other side there follows such a train of consequences, as seem to shock the Scripture-History of ye novelty of the World; at least they overthrow the opinion generally received... that since ye first Creation there have been no species of Animals or Vegetables lost, no new ones produced. But whatever may be said for ye Antiquity of the Earth it self & bodies lodged on it, yet there ye race of mankind is new upon ye earth, & not older than ye Scripture makes it, may I think by many arguments be almost demonstratively proved... (Ray 260)

It is evident that Ray is battling between his Christian beliefs and his scientific findings. Ray's work is unable to satisfy his questions concerning the Earth's age and history, but the following generations of geologists would address and answer these questions. As Ray is a naturalist like Woodward, he also struggles to find common ground between theology and science. However, their theories agree and disagree on a number of points. While Woodward believes the Universal Deluge left behind fossils, Ray argues that it is more likely fossils were a result of the first unveiling of dry land from beneath a universal body of water. Both of these theories rely on the complete coverage of the entire Earth with water at some point in the Earth's history. Robert Hooke's fossil theory does not include the total submersion of the Earth's surface but addresses different questions about fossils that build upon and add to this emerging fossil theory of the late seventeenth-century.

Robert Hooke was a seventeenth-century scientist who engaged with various scientific disciplines. He was known to be a 'virtuoso', meaning he was able to make significant contributions to many scientific fields. In his early years as Robert Boyle's assistant, he studied the physics of air and other gases. During the rest of his career, Hooke notably "worked out the correct theory of combustion; devised an equation describing elasticity that is still used today ("Hooke's Law")... invented or improved upon meteorological instruments such as the barometer, anemometer, and hygrometer; and so on" (Waggoner, *Robert Hooke 1635-1703*). One of Hooke's most significant inventions, the compound microscope, significantly aided in his formulation of a fossil theory and allowed him to discover previously unknown facts about fossil formation. This

microscope serves as an extension and enhancement of human sense in Hooke's work, which allows his findings to remain first-hand observations.

Hooke's 1665 publication, *Micrographia*, is his largest contribution to biological studies. This book contains many accurate descriptions and hand-drawn images of his microscope observations. One of his most significant additions to biology found in this text was his discovery of plant cells and cell walls. This discovery occurred as he observed small pieces of cork under the microscope:

I took a good clear piece of Cork, and with a Pen-knife sharpen'd as keen as a Razor, I cut a piece of it off, and thereby left the surface of it exceeding smooth, then examining it very diligently with a *Microscope*, me thought I could perceive it to appear a little porous... and casting the light on it with a deep *plano-convex Glass*, I could exceeding plainly perceive it to be all perforated and porous, much like a Honey-comb... First, in that it had a very little solid substance, in comparison of the empty cavity that was contain'd between, as does more manifestly appear by the Figure A and B of the XI. *Scheme*, for the *Interstitia*, or walls (as I may so call them)... (Hooke 120).

The magnification of the microscope allows Hooke to examine tiny details of plant structure that scientists were unable to observe before. Hooke's discovery led to further scrutiny of plant cells, which guided modern science to a greater understanding of these building blocks of life. Hooke's examination and understanding of structural, cellular division within plants also provides a foundation for his fossil theory.

Hooke was the first person to view fossils beneath a microscope. He also viewed organic matter, small creatures and other objects underneath the magnifying lens. The most significant finding towards Hooke's fossil theory arose when he compared petrified wood and fossilized shells to living wood and living mollusc shells. Using his new invention, Hooke observes close similarities between the physical structures of the living and fossilized objects on a microscopic level. He specifically examines the ridges found the fossil shells and compares them with fresh shells.

... some of them retain'd all along the surface of them very pretty kind of sutures, such as are observe'd in the skulls of several kinds of living creatures, which sutures were most curiously shap'd in the manner of leaves, and everyone one of them in the same Shell, exactly one like another, which I was able to discover plainly enough with my naked eye, but more perfectly and distinctly with my *Microscope*... (Hooke 110)

Using only the naked eye, Hooke approximately matches the fossil and living shells because of their large peaks, caverns, spirals, serpentine or helical shapes. From a microscopic comparison, Hooke concludes that the minute physical structures of the fossilized shells unarguably match those of the extant shells. In 1668, he announced his findings as proof that fossils derive from once-living creatures or plant matter (Waggoner, *Robert Hooke 1635-1703*). Further examination of petrified wood and fossils led to increasingly significant conclusions on the chemical formation of fossils. In *Mircographia*, Hooke explains his comparison of petrified wood with a piece of rotten wood.

This petrify'd Wood having lain in some place where it was well soak'd with petrifying water (that is, such water as it well impregnated with stony and earthy particles) did by degrees separate, either by straining and filtration, or perhaps, by precipitation, cohesion or coagulation, abundance of stony particles from the permeating water, which stony particles, being by means of the fluid vehicle convey'd, not onely into the Microscopial pores... but also into the pores or Interstitia... of that part of the Wood, which through the Microscope, appears most solid... (Hooke 109)

Hooke reveals one of the first proposed processes of how living creatures or organic matter may turn into fossils. He highlights the importance and necessity of water to this process. By examining soaked and rotten wood through a microscope, Hooke observes that the water easily saturates all of the structured plant cells. From this osmotic observation, he concludes that water rich in dissolved minerals would be capable of depositing these minerals throughout the wood. He concludes that water, or some sort of liquid vehicle, becomes extremely necessary to the fossilization process. Minerals must be able to penetrate the organic substance in order to take and maintain the shape of the object. Hooke's conclusions reveal that water performs a much greater role in the process of fossilization than merely a vehicle to transport fossils around the globe.

Upon considering the locations of marine fossils found far away from any water body, Hooke does not believe a Universal Deluge is a factor in transporting these objects. However, he does argue that some natural forces may move fossils from their original resting place.

I cannot but think, that all these, and most other kinds of stony bodies which are found thus strangely figured, do owe their formation and figuration not to any kind of *Plastick virtue* inherent in the earth, but to the Shells or certain Shell-fishes, which, either by some Deluge, Inundation, Earthquake, or some such other means, came to be thrown to that place, and there to be fill'd with some kind of Mudd or Clay, or *petrifying Water*... which in tract of time has been settled together and hardned in those shelly moulds into those shaped substances we now find them. (Hooke 111)

Hooke presents the Earth as a place of perpetual motion and he maintains that this action possesses the power to change the physical appearance and structure of the globe. After Hooke's death, Richard Waller published a number of Hooke's works and lectures in *Lectures and Discourses of Earthquakes and Subterraneous Eruptions*. In this compilation, Hooke examines large-scale natural forces and their impact on the Earth. He explains,

The major upheavals suffered by the earth in terms of the dynamics of a rotating body... Shifts in the axis of rotation, which Hooke believes to have taken place even in historical times, would introduce changes in the portion of the globe subject to the greatest forces. Thus, mountains may form where there had previously been seas, explaining the presence of fossil shells in mountainous regions. (Pugliese '*Hooke, Robert (1635-1703)*')

Instead of observing the physical world as a finite structure, unchanged since God's creation, Hooke suggests that the Earth has been altered in the past and continues to

transform in present time. He argues that large-scale earthly phenomena significantly changes the structure of landmasses and is responsible for the strange locations of fossils discovered around the world. Woodward addresses many similar questions and theories as Steno, Ray and Hooke, and like each of these scientists approaches these questions in a unique manner with a different focus and theory.

Despite Woodward's attention to the problematic issues of other scientists' theories in the first part of his essay, he admits, "... although they have not succeeded in their Attempts about the Origin of these [fossils], they have made Discoveries in other Respects concerning them, and in other Parts of Nature likewise, of that Moment and Consequence, as to have thereby laid a great and lasting obligation upon the intelligent and discerning Part of Mankind" (21). Woodward recognizes the contributions scientists can make to the greater knowledge of humankind, even if they are not entirely accurate or correct in their initial hypotheses. While Woodward's text is problematic for its abundance of contradictions, it is necessary to remember that it still contributes to scientific scholarship by proposing many valuable ideas and theories. The fossil theories proposed by Steno, Ray, Hooke and Woodward all provide different perspectives and pieces of this scientific puzzle.

The geographic location of these marine fossils is Woodward's primary supporting evidence of the occurrence of the Universal Deluge. He begins his examination of fossils by questioning the source of these relics and focusing on how they came into existence: "... I hope to make out, that the Sea gave Birth to these Bodies: that they are so far from being formed in the Earth, or in the Places where they are now

found... these Shells were not formed (in the Earth), but had Being before ever they came thither: and were fully formed and finished before they were reposed in that Manner” (21-22). Woodward argues that the shells existed in the sea *before* they came to rest on land and were later buried in the soil, therefore proposing that a length of time is necessary for this result to occur. While he does not reveal how long this process would take, it is evident that he believes the relocation of these fossils did not occur recently. Woodward’s belief that these fossils did not originate in the soil, but in an aquatic environment, suggests that some force must have physically relocated them to their present position. These hypotheses support his argument that a great flood, perhaps at the supposed time of the Universal Deluge, could have been the force that moved the fossils from the sea onto dry land. Woodward intends to prove that these fossils are originally from an aquatic environment by comparing their physical likeness to living sea creatures. He observes “such vast Multitudes of Shells contained in Stone, &c. Which are intire, fair and absolutely free from any such Mineral Contagion: which are to be match’d by others at this Day found upon our Shores, and which do not differ in any Respect from them; being of the same size, that those are of, and the same shape precisely: of the same substance and texture...” (Woodward 23). This observation of mineral involvement is interesting in comparison with Hooke’s fossil theory. Hooke suggests that petrifying water chemically alters the marine shell, turning it into a mineralized fossil of the original object. Woodward conversely argues that stone and earth encase the fossils, but do not chemically alter them with minerals, “for the Metallick and Mineral Matter which sometimes adheres to the Surfaces of these Shells, or is intruded into their Pores, and

lodged in the Interstices of their Fibres, 'tis all manifestly adventitious; the Mineral Particles being plainly to be distinguished from the testaceous ones..." (22). Without the aid of a microscope, Woodward is unable to view the minute structural differences between a living and fossilized shell, which are indicative of a chemical transformation. However, Woodward does conclude that minerals in the soil interact with the shells and slightly change the physical appearance of the fossils from the original living specimens. Although he notes a clear physical difference between the fossilized and extant shells, they are similar enough in shape, size and chemical behaviour for Woodward to link them together.

Nay farther, they answer all Chymical Tryals in the like Manner as the Sea-Shells do: their Parts when dissolved have the same Appearance to View, the same Smell and Taste: they have the same Vires and Effects in Medicine, when inwardly administered to Animal Bodies... In a Word, so exactly conformable to the marine ones are these Shells, Teeth, and Bones, which are digged up out of the Earth...

(Woodward 25)

Through the comparison of these shell fossils with living marine creatures, he claims it is evident that the fossils derive from an aquatic environment, even though he finds them presently on dry land. Woodward's observations undoubtedly link the fossils and marine creatures together, further supporting his theory that the fossils have relocated from their original environment.

Woodward examines the depth of the fossils' locations in the earth as further support for the existence of the Universal Deluge. Woodward agrees with Steno's

Principle of Original Horizontality, and observes the stratification of the earth in the layering of different substances beneath the surface. However, Woodward concludes that the systematic layering is due to gravitational particle weights instead of by Steno's temporal scheme. Woodward concludes that the heaviest substance is the lowest visible layer, while the lightest substance rests at the surface of the earth:

... at the time of the Deluge (when these Shells were brought out upon the Earth, and reposed therein in the Manner we now find them) Stone, and all other solid Minerals lost their Solidity: and that the sever'd Particles thereof, together with those of the Earth, Chalk, and the rest, as also Shells, and all other Animal and Vegetable Bodies, were taken up into and sustained in, the Water: that at length all these subsided again promiscuously, and without any other Order than that of the different Gravity of the several Bodies in this confused Mass; those which had the greatest degree of Gravity sinking down first, and so settling lowest; then those Bodies which had a lesser Share of it fell next, and settled so as to make a Stratum upon the former... (Woodward 31)

Woodward describes the swirling deluge as mass of chaotic disorder in which water takes up all solid matter on Earth and consumes it. He then describes how the solid particles came to settle into dry land, also restructuring the location of all the animal and vegetable bodies on the globe. Through this description of swirling organic matter, Woodward creates a direct link between the power and force of water, and the arrangement of fossils in the strata:

All those which had the same degree of Gravity subsided at the same Time, fell into, and composed the same Stratum. So that those Shells and other Bodies, that were of the same Specific Gravity with Sand, sunk down together with it, and so became inclos'd in the Strata of Stone, which that same form'd or constituted. Whilst those which were lighter, and of the same specific Gravity with Chalk... fell to the Bottom at the same Time that the Chalky Particles did, and so were entombed in the Strata of Chalk... (Woodward 32)

Woodward's idea that each individual layer formed because of a difference in gravitational weight is interesting. He uses the various locations of the fossils in different layers to prove that some force physically reorganized them, thus opening up the possibility that this same force removed the fossils far from their original geographic location. The separation of the fossils within the strata layers becomes Woodward's proof that the Universal Deluge is a true historical event. By extension, the physical layering of the strata also becomes proof of the great flood. Since Woodward is unable to physically observe or reconstruct this massive event, the stratification of the Earth and fossils becomes the physical evidence he requires to pursue his hypothesis.

This observable proof, however, becomes problematic upon his discovery that some fossils that do not visibly match living creatures or plants. Woodward admits that a number of the shell fossils he discovers do not physically link to any species currently present on the shores. He states, "notwithstanding this, I cannot but affirm that these, even the most strange and enormous of them, have all the essential Notes and Characters of Sea-Shells, and shew as near a Relation to some as now extant upon the Shores as the

different Species of those themselves do to one another” (26). This statement reveals that Woodward is thinking beyond the Baconian methodology. He also ignores Ray’s conclusion that scientists are merely ignorant of the current whereabouts of these strange species. Woodward is creating new hypotheses based upon his discoveries as well as his imagination, although he cannot prove his theories with observable facts. It is significant to note that he not only considers the possibility of extinction, but he also draws a relationship between these living and extinct species. His forward-thinking speculation anticipates evolutionary theory and significantly transcends both scientific and religious limits of the seventeenth century. Woodward’s theory is that these unknown fossils are remains of extinct relatives of existing creatures, that these similar looking creatures are somehow biologically related. This suggests that direct physical observations cannot essentially provide all of the necessary scientific knowledge about the natural history of the Earth. Science must extend beyond physical proof, using hypotheses and guesswork to push the boundaries of human knowledge. Conversely, this theory also combats the Biblical narrative of Genesis, which states that the existing world is God’s original creation and that nothing pre-existed this present state. This interaction with Genesis ideology becomes significant in Woodward’s analysis of gravity seen later in his essay. While Woodward uses the Biblical narrative of the Great Flood as a foundation for his research, he questions the limitations of a finite Christian world. In Woodward’s attempt to fuse the scientific discipline with religious doctrine, he transcends the boundaries of both and thus opens his text to innovative ideas and hypotheses that anticipate future discoveries.

The attention to water in all four fossil theories discussed in this section reveals a significant link between the research conducted by Steno, Ray, Hooke and Woodward in the seventeenth and early eighteenth-centuries. Whether these men discuss water from a religious context or for a scientific hypothesis, they each recognize the physical power of water on the Earth. These four fossil theories form the foundation for modern fossil research, and all of these hypotheses observe water as a major factor in the formation of fossils or their geographic locations.

Chapter 3

Water

Woodward is not confined to the terrestrial parts of the globe, but extends his observations to the aquatic environment: “Water of Mines, of Grotto’s, and other such like Recesses, as those upon the Surface of [the Earth], the Sea, Rivers and Springs” (3). It is important that Woodward examine all the water systems of the modern world, as he believes they are the source of the Universal Deluge. He argues it is scientifically possible that enough water exists to cover the entire Earth simultaneously, aligning with the Biblical account of the Great Flood, although some of this water is not currently visible. Woodward claims it is most likely that underneath the Earth’s crust, “there is at this Day resident, in that huge Conceptacle, Water enough to effect such a Deluge, to drown the whole Globe, and lay all, even the highest Mountains under Water” (A4R). It is evident to Woodward that the size and the height of the Earth would require an immense quantity of water to engulf all of the landmasses entirely. Through his research of the storehouses of water on Earth, he concludes that there is not enough visible water to submerge the globe. In Part III of his text, Woodward lists a number of hypotheses by other theorists that attempt to conjecture the location of this mass of water. He specifically focuses on Thomas Burnet’s *The Theory of the Earth* and directly quotes from passages of this 1759 text. Burnet’s theory explores the possibility of the Universal Deluge and hypothesizes about the Earth’s ‘paradise’ state before the flood.

Thomas Burnet, born in 1635, was a natural philosopher and became headmaster of Charterhouse School in 1685. Like Woodward, Burnet’s primary interest was the

history of the Earth, and he focussed much of his theory on the state of the Earth before and after the Universal Deluge. Burnet theorized that, before the flood, the Earth was an oval shape, not spherical, and that the axis of the Earth was different, resulting in perpetual spring in paradise. Furthermore, he argues that the Deluge changed this original state of the Earth into its present physical form. Burnet expanded on these theories in *The Theory of the Earth*, originally published in Latin in 1681. He then produced a number of revised editions of his original text, with the last few editions titled *The Sacred Theory of the Earth* published between 1719 and 1759. In this text, Burnet famously attempts to calculate the volume of water necessary to cover the entire Earth in a Universal Deluge. By estimating the average depth of the seas and the height of the mountains, Burnet concludes:

... there would need four oceans to lie upon this ocean, to raise it up to the top of the mountains, or so high as the waters of the deluge rise; [and] four oceans more to lie upon the land, that the water there might swell to the same height; which together make eight oceans for the proportion of the water required in the deluge... or a quantity of water eight times as great as the ocean, to bring an universal deluge upon the earth, as that deluge is ordinarily understood and explained. (11-12)

While Burnet provides a very loose estimate of this volume, his figure of eight times the water in the oceans reveals his understanding of the massive scale of such an event. His calculation considers the amount of water present on the globe within water bodies, rivers, underground recesses and the atmosphere. Burnet concludes that the visible

quantity of water on Earth cannot possibly cover all of the dry land simultaneously, especially since this would include the coverage of mountain ranges, which stand a vast height above sea level. However, he argues that the flooding of a large land mass is feasible:

If it had been only the inundation of a country, or of a province, or of the greatest part of a continent, some proportionable causes perhaps might have been found out; but a deluge over-flowing the whole earth, the whole circuit and whole extent of it, burying all in water, even the greatest mountains in any known parts of the universe, to find water sufficient for this effect, as it is generally explained and understood, I think it impossible. (9-10)

Burnet considers the flooding of a large area to be a natural and possible occurrence, but the complete submersion of the entire Earth is beyond the physical limitations of the globe. His declaration of the Universal Deluge as ‘impossible’ conversely reflects upon God’s power to create this flood, and proclaims divine intervention as equally impossible.

Burnet’s emphasis on the massive volume of water required to immerse all dry land evokes a feeling of the sublime. The concept of the sublime became prominent in English literature in the seventeenth and eighteenth centuries. The sublime describes a mixed feeling of awe and fearfulness of a large physical construct or force that is incomprehensible to the human mind. This concept often refers to the human inability to understand nature. A popular example is an extremely large mountain that a person cannot entirely view at once, and this structure is so overwhelming that one experiences feelings of both awe and fear simultaneously. When considering the amount of water

necessary to cover the Earth, Burnet admits, “This I confess will make a prodigious mass of water, and it looks frightfully to the imagination; it is huge and great, but it is extravagantly so, as a great monster: it doth not look like the work of God or nature...”

(10). The scale of the Universal Deluge seems so large that it becomes difficult to comprehend the flooding of the entire Earth and the amount of water necessary for such an event. This volume is unfathomable and if such an event were to occur, it would be awe-inspiring. Burnet proclaims that the world does not nearly possess this vast amount of water. Woodward specifically addresses Burnet’s declaration that the water present on Earth could not create a Universal Deluge: “he prepares for a Surrender, asserting, from a mistaken Computation, that all these (stores of water) will not come up near to the Quantity requisite... Having therefore over-hastily concluded that such a Deluge was *impossible...*” (177-178). Woodward questions Burnet’s ability to calculate the accurate volume of water necessary for a flood of this scale. He argues that Burnet ignores some key facts about the Deluge and therefore cannot achieve an accurate calculation.

Woodward emphasizes that Burnet’s assertion is most offensive because it disregards Moses’ account of the Universal Deluge. As a witness to the Deluge, Woodward regards Moses as a factual historian and thus his eyewitness accounts are necessary components in this endeavour. Burnet’s disregard of Moses’ teachings subverts the Baconian inclusion of all facts and observations, which makes it problematic from Woodward’s perspective.

It is possible to consider Woodward’s section on water as a response to Burnet’s theories and as a defense of the validity of Moses’ texts. Woodward wishes to reinforce the importance of Moses’ texts to the scientific enquiry of Creation and question the

validity of new hypotheses that leave these ancient texts out of their investigation.

Woodward includes himself in a group of the “sober and better Sort of the Standers-by, and those who were Well-wishers of Moses, [who] began to be under some Concern and Uneasiness to see him thus set aside only to make Way for a new Hypothesis” (178). He attempts to convince his readers that clear-headed and ‘better’ thinkers appreciate Moses’ contributions to the understanding of the Universal Deluge. Conversely, other theories, such as Burnet’s, which disregard Moses as a historian, are very radical ideas and readers should not accept such hypotheses without question. Woodward states that supporters of Burnet’s theory:

... cry’d up his Computation of the Water as indisputable and infallible: and then boldly gave out that such a Deluge as that described by Moses was altogether incredible, and that there never was nor could be any such Thing... they had here sprung a fresh and unanswerable Argument against the Authentickness of the Mosaick Writings; which indeed is what they drive at, and a Point they very fain would gain. (179-180)

In this statement, Woodward reveals his concern about the separation of science from religion. He indicates this problem revolves around Old Testament hermeneutics. As the number of scientific hypotheses that disregard Biblical narratives increases, the less important religion becomes to the advancement of science. Woodward connects the dismissal of Moses’ teachings to Burnet’s desire to invalidate the Creation narrative and other Old Testament texts. Woodward argues that the rejection of Moses by Burnet’s followers is a direct move to eliminate religious authority over the history of the Earth. As

a physico-theologian, Woodward opposes the separation of science from religion and thus finds Burnet's text to be highly problematic.

Burnet finds many conflicts between Moses' words and his scientific observations of the natural world. He highlights the problem that Moses only directs his readers to the clouds above, the deeps below and the bowels of the Earth as sources for the deluge, which is inconsistent with the volume of water he observes in the present state of the globe (13). He argues that not all of the observable water can possibly amass to the volume needed for the Universal Deluge. Therefore, he states, "the next thing to be done, is to enquire where this water is to be found; if any part of the sublunary world will afford us so much: eight oceans floating in the air make a great bulk of water; I do not know what possible sources to draw it from" (Burnet 12). He considers that the Universal Deluge could be possible if an excess of water was hidden somewhere within the Earth. At this time, many scientists such as Burnet and Woodward considered the idea that the centre of the Earth contained an extremely large storehouse of water. Burnet connects this theory to Moses' discussion of the 'great abyss':

Moses tells us, that the fountains of the great abyss were broke open, or *clave asunder* as the word there used doth imply... but we are here to consider what is generally understood by the great abyss, in the common explication of the deluge; and it is commonly interpreted either to be the sea, or subterraneous waters hid in the bowels of the earth: these, they say, broke forth and raised the waters, causes by the rain, to such an height, that together they overflowed the highest mountains. (14)

However, if the center of the Earth does contain water, he is unsure how these waters could emerge and flood the Earth without leaving a void in such subterranean caverns. Burnet provides the example of two containers to explain this concept to his reader: “If you have two vessels to fill, and you empty one to fill the other, you gain nothing by that, there still remains one vessel empty, you cannot have these waters both in sea and on the land, both above ground and under...” (15). Burnet argues it is impossible for the interior waters of the Earth to emerge suddenly against the force of gravity and the suction of the interior void. He concludes that a deluge of this manner could not happen naturally and thus it would require supernatural force to release the waters from the inner recesses of the Earth. Even considering the interference of supernatural force, Burnet remains skeptical of the Universal Deluge and concludes that all his evidence dismisses the occurrence of this phenomenon. He is aware that many people disagree with his conclusion that the Universal Deluge is physically impossible and addresses these reactions to his work:

And to this they say in short, that God Almighty created waters on purpose to make the deluge, and then annihilated them again when the deluge was to cease; and this, in a few words, is the whole account of the business. This is to cut the knot when we cannot loose it; they shew us the naked arm of omnipotency; such arguments as these come like lightening, one doth not know what armour to put on against them, for they pierce the more, the more they are resisted... (Burnet 18)

Burnet continues to dispute the possibility of God’s sudden creation of excess water through the further examination of facts found within Moses’ texts. He emphasizes the

necessity of a law-bound natural world. Burnet states, “let them consider, that Moses hath assigned causes of the deluge; *forty days rain, and the disruption of the abyss*; and speaks nothing of a new creation of water upon that occasion... now this manner of the beginning or ceasing of the deluge doth not at all agree with the instantaneous actions of creation and annihilation” (19). If Moses’ text is to be considered entirely factual and accurate, this evidence contradicts the theory that God created and destroyed an excess amount of water in the formation of the Universal Deluge. However, Burnet states that he cannot entirely deny the possibility of a Universal Deluge because of the number of records of such an event from around the world: “And we cannot without offering violence to all records and authority, divine and human, deny, that there hath been an universal deluge upon the earth; and if there was a universal deluge, no question it was that of Noah’s...” (27-28). While Burnet then proceeds to offer a different theory for the Deluge, what is important to recognize is that he specifically denies the authority of the Biblical narrative. Burnet’s *Theory of the Earth* suggests that the scientific observation of the world can reveal a more accurate understanding of natural history than religious narratives. His work questions the accuracy of ancient texts through scientific observations and evidence. This attack on religious authority using scientific proof separates the two disciplines and places them in direct opposition. Burnet’s conclusions significantly affect Woodward’s theories of the Universal Deluge and contest the validity of physico-theology as a scientific discipline.

Despite Burnet’s need for explicit proof of the location of the Deluge floodwaters, Woodward states, “for my Part, my Subject does not necessarily oblige me to look after

this Water: or to point forth the Place whereunto 'tis now retreated" (180). Woodward believes he is able to prove the Deluge is possible without discovering the source of the water. He argues the inland locations of the seashell fossils provide him with "undeniable Evidence that it did actually cover all Parts of the Earth, it must needs follow that there was then Water enough to do it, wherever it may be now hid, or whether it be still in being or not" (Woodward 180). Woodward insists that some powerful force must have relocated the marine fossils to their present terrestrial environment, ensuring that he supports his speculations with physical evidence. Woodward observes that these marine fossils are submerged within dry land and rocks. He postulates the stratigraphic separation of the fossils is conclusive evidence that the Biblical flood physically relocated these objects from their original position on the surface of the Earth. This assumption reflects Woodward's divergence from Baconian methodology and further reliance on hypotheses and speculation. As further proof of the Deluge's physical power, Woodward also examines the erosion of the terrestrial globe and focuses on water's ability to change the physical form of the Earth. These alterations of the land combined with the geographic locations of the fossils provide the scientific foundation for Woodward's argument.

Woodward locates the origin of his discovered terrestrial fossils to marine environments because of their physical resemblance to shells and aquatic creatures. He then charges this relocation to the power of the Universal Deluge. This claim requires him to explore ways in which a massive volume of water could move the shell fossils so far away from an aquatic system and also embed them in solid rock. Woodward examines the

continuous effect of water on solid earth, specifically the force of erosion, as proof of water's power and ability to change the physical world. Before speculating about the specific alterations to the Earth by the Universal Deluge, Woodward chooses to examine present changes he observes of the land:

That Rocks, Mountains, and the other Elevations of the Earth (especially those whose Surfaces are yearly stirr'd and disturbed by digging, plowing, or the like) suffer a continual Decrement, and grow lower and lower; the superficial Parts of them being by little and little wash'd away by Rains, and borne down upon the subjacent Plains and Valleys. That even the Stone it self (whether naked and uncover'd as in Rocks, or invested with a Stratum of Earth as is that in our ordinary Hills) is not, by its Solidity, privileged and secur'd against them, but is dissolved by degrees... (253)

In this passage, Woodward engages with the concept of aquatic erosion, noticing the continual wearing away of the terrestrial landscape by precipitation. He also examines shoreline erosion by the waves of large bodies of water, which clearly links to his understanding of the Deluge and its interaction with dry land. Woodward notes that aquatic erosion affects all terrestrial matter, including dense materials such as stone. However, he admits this process wears down the Earth very slowly, prompting his conclusion that, "though this Devolution be thus different, 'tis not any where, even where greatest, very considerable: and therefore does not make any great Alteration in the Face of the Earth" (258). Woodward maintains the Christian Biblical timeline, assuming that only approximately four thousand years have passed since the Universal Deluge, and thus

resolves that the slow process of erosion since this event could not have a considerably visible effect on the physical appearance of the Earth's surface. Instead, if Woodward had applied his findings to our current estimate of the Earth's age, approximately 4.5 billion years old, he would possibly conclude erosion to have very large effects on the world's landmasses. The length of time amplifies the effects of erosion. However, Woodward approaches this problem from a different perspective, assuming that a larger amount of water, instead of more time, would amplify the effects of erosion. Thus, he concludes that the only significant change to the physical Earth by erosion would be during the Universal Deluge because of the vast amount of water assumed to be present on Earth. As the Universal Deluge is an event Woodward is unable to replicate or witness firsthand, his ability to observe the effects of erosion provides essential support to his hypothesis about the flood. In addition to the effects of erosion, he also considers "other Casualties that the Globe is obnoxious unto, such as Earthquakes, and the burning Mountains, or Volcanoes... [which] do make some lesser Alterations in some few Parts of the Earth" (259). However, he believes these natural events do not make a momentous change to the physical appearance of the Earth and that the only significant modification of the terrestrial globe came at the time of the Universal Deluge.

Although Woodward observes the breaking down of the earth by erosion, he does not consider the Deluge to be a damaging or detrimental force. He supports this position by examining the postdiluvian state of the globe and the 'gentle' effects of water on dry land. While other theorists speculate alterations by erosion would be destructive, he argues, "these Alterations are of quite a different Strain: these are as amicable and

beneficent to the Earth and terrestrial Bodies” (249). He argues that the surface layer of the Earth’s stratum is in a state of continual flux. Minor forces, such as rain, plowing and animal treads, perpetually supply the surface of the Earth with organic matter necessary for the formation of vegetables and other plants. He argues that rainwater has a similar effect on plant matter as it dissolves minerals from hills and mountains through the process of erosion:

That the Matter, which thus devolves from the Hills down upon the lower Grounds... or carry’d along with the Rain-water into Rivers, and, by them, into the Sea; whence ‘tis returned back again to the Earth dispersedly by Rain, and serves for the Nutriment and Formation of the Plants which grow thereon: and the rest of it, being more crass and ponderous, does not move far, but lodges in the Clefts, Craggs and Sides of the Rocks or Mountains, and at or near the Roots or Bottoms of them. (254)

Woodward describes the waters as a positive force on the globe, continuously modifying the face of the Earth and providing essential services for the continuation of life on Earth. This suggests these changes are purposeful, not random without use or end. Woodward speculates that all forces on Earth are evidence of God’s existence and involvement. The facts he provides do not effectively support his conclusions and this major outgoing shift reinforces Woodward’s divergence from Baconian methodology.

In *The Natural History of the Earth*, the representation of the power of water directly links to God’s authority upon the Earth and His power to change the world. Woodward’s description of erosion as a positive, productive change upon the Earth

reveals his understanding that the force of water is an extension of the divine will and providence. This gentle aquatic force represents God and nature as benign. In describing the original state of the Earth, he states, “that the Face of the Earth, before the Deluge, was not smooth, eaven, and uniform: but unequal, and distinguish’d with Mountains, Valleys, and Plains: as also with Sea, Lakes and Rivers” (Woodward 270). The Deluge functions to erode and change this uneven surface. Woodward claims this is a tendency of water to equalize the elevations of the globe, reflective of God’s balancing hand. He emphasizes the divine purpose of the world’s water, quoting Genesis on God’s creation of the seas and that “God saw that it was good” (274). Upon considering this passage from Genesis, Woodward notes, “that Moses hath here used a Word that was common and known to signify the Sea. According to him therefore, we see the Sea was formed at the Beginning of the World, and after its Formation approved of as good: that is, very necessary and serviceable to the Ends of Providence in the Kingdom of Nature” (274). It is significant for Woodward to prove that God created the seas at the very beginning of the Earth’s existence, as this gives the water a direct purpose on Earth. Woodward speculates that the force of water enables God’s physical modification of the landscape and that this continuous change is the will of God.

Woodward’s interpretation of water as a gentle and divine force, and the Deluge as an extension of God’s benevolent hand, becomes problematic in comparison with the original narrative from Genesis. The Old Testament version of God is much more wild and unruly than the loving God of the New Testament, as Woodward understands Him. In Genesis, the purpose of the Universal Deluge is not to improve or gently modify the

physical Earth. God brings forth the waters of the Deluge in order to destroy all creatures on Earth:

The earth also was corrupt before God, and the earth was filled with violence. And God looked upon the earth, and, behold, it was corrupt; for all flesh had corrupted his way upon the earth. And God said unto Noah, The end of all flesh is come before me; for the earth is filled with violence through them; and, behold, I will destroy them with the earth. (Genesis 6.11-13)

God reveals his frustration with humankind and His own creation of all life on Earth. While Woodward argues that the Universal Deluge was a very powerful force on the terraqueous globe, he softens the perception of God's malicious act and limits any association of the flood to violence or death. Perhaps it is likely that Woodward avoids connecting the Deluge to God's brutality, as his readers may not view the flooding of the Earth as a positive sign that God does exist. Instead, the image of a spiteful God would leave Christians in a state of fear instead of loving worship. By diminishing the correlation between the Deluge and God's violent anger, Woodward attempts to propose a different relationship linking God with society. He argues that God's active role in the physical creation, modification and maintenance of the Earth is positive for humankind because he is constantly watching over and protecting the Earth. Woodward chooses to emphasize proof of God's consistent and caring presence, such as the continual effects of water on Earth, instead of a singular violent event. Woodward expands on God's constant care over the Earth in his discussion of gravity, the consistent force that draws all matter toward a single, common point at the center of the Earth.

While the presence of a sufficient amount of water on Earth would support the possibility of a worldwide flooding, Woodward's argument is polemical. This hypothesis of a watery abyss diminishes God's role in the Universal Deluge, as his divine power is no longer necessary to create and destroy an excess amount of water. The existence of the Great Abyss allows for the possibility that God did not intervene with the Earth at all and that natural laws limit His power. It thus becomes conceivable that a flood could have occurred without divine intervention. A restricted version of God is also problematic for Woodward's argument of Biblical accuracy, since the Bible represents God as an all-powerful Being. Ultimately, this problem rests with the reading of the Old Testament, and the individual interpretations of God's omnipotence.

Chapter 4

Gravity

Woodward's theory of the Universal Deluge considers gravity as the primary contributing force to the stratigraphic layering of the earth, and the location and depth of the fossils found within it. Sir Isaac Newton, gravity's chief theorist, had the highest public reputation of any scientist from the late seventeenth-century and early eighteenth-century. He is notably the first scientist to theorize gravity as a universal property of all matter (Gjtersen 236). Many of his theories and calculations are still applicable to modern science and are fundamental to current studies of physics. The foundation of much of his work rests on mathematics and his recognition of patterns within mathematical problems and sequences. While his focus is the understanding of scientific calculations, Newton applies these mathematical laws to the motion of physical bodies and the study of optics. During his *anni mirabiles* years of 1665-1666, Sir Isaac Newton began to think about the scientific principles of gravity and apply his questions and theories to the Earth, the Moon and other celestial bodies (Westfall "Newton, Sir Isaac 1642-1727"). His improvement in the comprehension of gravitational forces is perhaps his most significant contribution to the understanding of the physical world and natural philosophy during Woodward's lifetime. Newton's theories on the forces of gravity were an extremely important influence upon Woodward's discussion of gravity in his *Essay towards a Natural History of the Earth*. The inclusion of Newton's theories allows him to capitalize on the popularity of this innovative concept and ensure that contemporary scientists will read his work.

Although Newton's studies offer advances in mathematics and science, he is also fascinated with theology and many of his works focus on Biblical hermeneutics and occult studies. His reading and interpretation of the Bible led him to conclusions that differed from orthodox Christianity. He primarily disagrees with the concept of trinitarianism, arguing that "Christ was not an eternal part of the Godhead but a created intermediary between God and man, a doctrine similar but not identical to modern Unitarianism" (Westfall "Newton, Sir Isaac 1642-1727"). Newton clearly does not blindly follow the traditional model of revealed religion, instead choosing to ask questions about Biblical narratives and Christian doctrine. While Newton finds distinct interest in both the logical and theological understanding of the world, he frequently combines these two disciplines in his theories and published texts. Newton's *Philosophiae Naturalis Principia Mathematica*, or *Mathematical Principles of Natural Philosophy*, published in 1687, engages with the mathematical study of the world and the behaviour of objects subjected to physical forces. This text includes discussion on the innovative concept of gravity, its function and influence on the physical Earth, which is crucial to Woodward's understanding of gravity and the application of gravitational forces to his theories about the Universal Deluge. Newton incorporates mathematic calculations into all of his observations as support and proof of his conclusions about the motion of bodies. He explains his desire to explore mathematics as a continuation and expansion of ancient and modern theories:

Since the ancients (as *Pappus* relates) esteemed the art of mechanics of the greatest importance in natural inquiries; and the moderns, rejecting substantial

forms and occult qualities, have endeavoured to reduce the phenomena of nature to the laws of mathematics; I have thought proper in this treatise to cultivate the science of mathematics, as far as it relates to philosophy. (xxxiii)

The *Principia* follows this direction, blending mathematics with philosophical theory about the natural world and drawing conclusions from the comparison of these two disciplines. Newton, like Woodward, navigates ancient and modern theories, while incorporating his own speculations and conclusions. He also participates within the current scientific discourse of the period by infusing the theories of other scientists in his work. He most frequently refers to Robert Boyle's vacuum chamber experiments and his own use of Boyle's invention in gravitational experiments.

Mathematical equations and explanations comprise the vast majority of the *Principia*, with little deviation from factual knowledge as Newton generally avoids including speculations and assumptions. However, the final section of the *Principia*, entitled 'General Scholium', expands on Newton's numerical conclusions and suggests explanations for phenomena that he cannot mathematically prove. He combines his factual findings and calculations with his understanding of God and His presence in the universe:

This most beautiful System of the Sun, Planets and Comets, could only proceed from the counsel and dominion of an intelligent and powerful being. And if the fixed Stars are the centers of other like systems, these being form'd by the like wise counsel, must be all subject to the dominion of One; especially since the light of the fixed Stars is of the same nature with the light of the Sun... And lest the

systems of the fixed Stars should, by their gravity, fall on each other mutually, he hath placed those Systems at immense distances one from another. (Newton, *Mathematical Principles of Natural Philosophy* 388-389)

Newton's discovery of universal laws of gravity and motion in the solar system reveal the orderliness and exactness of the movement of planetary bodies. He links this precision to God's participation in the organization of the cosmos. Newton argues that God is aware of gravitational laws and accounted for this behaviour of planetary bodies in His spatial planning of the universe. The universality of Newton's laws functions to extend God's supremacy; he is no longer only Lord of the planet Earth or even the solar system, but Lord of all systems and matter found in the Universe. Newton declares,

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*

ΠΑΝΤΟ-ΚΡΑΤΩΡ or *Universal Ruler*. For God is a relative word... The supreme God is a Being eternal, infinite, absolutely perfect; but a being, however perfect, without dominion, cannot be said to be Lord God... (*Principia* 389)

Newton argues that this vast authority elevates God above any other mortal ruler or pagan deity. The consistency of gravitational forces on Earth and throughout space reveals the perfection of the cosmos, which Newton believes is an indication of God's presence and involvement in the workings of the Universe. As Derek Gjertsen points out, "There is nothing here, however, of God as the loving father, nor is there any talk of the God of love. God is rather the Pantocrator or universal ruler; he has Dominion, he is Lord and we worship and adore him, not as trusting children, but as servants" (233). Newton separates

his discussion of God from the conventional Christian interpretation of God's demeanour. While he believes in the crucial presence of God in the universe, he does not project any sort of qualities or behaviours onto Him. This rejection of the conventional image of God serves to separate Newton's scientific and mathematical research from orthodox Christianity.

In the *Principia*, Newton explains the mathematical law of gravity, how it functions on Earth and in the motion of planetary bodies. While he proves gravity exists, he does admit that he has not discovered the actual cause of gravitational forces. Newton addresses this issue:

To us it is enough that gravity does really exist, and act according to the laws which we have explained, and abundantly serves to account for all the motions of the celestial bodies, and of our sea. And now we might add something concerning a certain most subtle Spirit, which pervades and lies hid in all gross bodies; by the force and action of which Spirit, the particles of bodies mutually attract one another at near distances, and cohere, if contiguous... and members of animal bodies move at the command of the will, namely, by the vibrations of this Spirit... But these are things that cannot be explain'd in few words, nor are we furnish'd with that sufficiency of experiments which is required to an accurate determination and demonstration of the laws by which this electric and elastic spirit operates. (*Principia* 393)

While Newton defines gravity as a universal attractive force between two physical bodies, he suggests that there is something more to gravity that he cannot mathematically prove

or observe. Newton argues that a single spirit infuses all physical bodies of the universe, but does not specifically name or define this spirit. He maintains that any physical object, whether an apple or a planet, is God's creation. Therefore, it is not unreasonable to conclude that Newton believes it is a divine spirit that embodies all material objects. As A.J. Snow argues, "Newton suggests indirectly and directly throughout his whole works another possible explanation which would contain the causes of gravity – an explanation the very opposite to a mechanical one; it is a metaphysical hypothesis of the existence of immaterial principles... It is God as an agent acting through a medium of space upon matter, space being the 'Sensorium of God'" (167). While the foundation of Newton's *Principia* rests on mathematical calculations, his reflections and conclusions in the 'General Scholium' suggest that a complete explanation of gravity requires an understanding of both physical science and God's power. He is able to use mathematics to prove the existence of gravitational law, but he is limited in understanding the cause of gravity because no experiments are capable of proving the existence and operations of this Spirit. However, this lack of observable evidence does not prevent Newton from postulating ideas and theories of God's involvement in the motion of matter.

Newton's later work, *Opticks: Or, A Treatise of the Reflections, Refractions, Inflections and Colours of Light* was first published in 1704 and offers significant contributions to science that rival those of the *Principia*. This text differs from the *Principia* as it primarily deals with the motion and behaviour of light, instead of physical bodies. *Opticks* contains an analysis of light as it reflects off surfaces, such as mirrors, and bends by passing through one medium to another, such as prisms, water and glass.

The text contains mathematical explanations of the behaviour of light and diagrams of the various experiments conducted by Newton. *Opticks* is similar to the *Principia* as it concludes with a set of Queries, which is reminiscent of the ‘General Scholium’. While many of the Queries pertain to the topic of light, some of Newton’s questions examine other aspects of his natural philosophy, including gravitational force. The first edition of *Opticks* contains sixteen queries, but this number increases as other editions appear. The fourth and final edition of *Opticks* contains thirty-one queries. The thirty-first query is the longest of the collection and stimulated much debate among scientists on the topic of chemical affinity, and the formation of chemical compounds. In this query, Newton discusses the effects of gravity, magnetism and electricity on small particles. His analysis of gravity’s effect on particles in a solution is similar to Woodward’s theory of the Universal Deluge:

Now, as in the great Globe of the Earth and Sea, the densest Bodies by their Gravity sink down in Water, and always endeavour to go towards the Center of the Globe; so in Particles of Salt, the densest Matter may always endeavour to approach the Center of the Particle: So that a Particle of Salt may be compared to a Chaos; being dense, hard, dry, and earthy in the Center; and rare, soft, moist, and watry in the Circumference. (*Opticks* 361-362)

Newton’s idea differs from Woodward’s conclusion that the center of the Earth draws all matter toward its center, because he applies gravitational theory to all particles. A grain of salt also possesses its own gravitational force; however, it is admittedly much weaker because of the size difference between the two physical bodies. The salt mirrors the same

attraction as the Earth, drawing the heaviest particles toward the dense center, while the lighter particles rest on the surface. Newton reveals the whole of the Earth as a montage, built from and consisting of an array of particles, both small and large:

And yet we are not to consider the World as the Body of God, or the several Parts thereof, as the Parts of God. He is an uniform Being, void of Organs, Members or Parts, and they are his Creatures subordinate to him, and subservient to his Will; and he is no more the Soul of them , than the Soul of Man is the Soul of the Species of Things carried through the Organs of Sense into the place of its Sensation, where it perceives them by means of its immediate Presence without the Intervention of any third thing... and God has no need of such Organs, he being every where present to the Things themselves. (*Opticks* 379)

Newton represents the world and its creatures as God's creations. However, he believes that God is not the physical summation of these parts. Newton's description of God and his analysis of gravity equate, as he determines there is no physical representation of either force. Both God and gravity are not physically observable forces, but it is possible to observe God's influence through the scientific analysis of the natural world in the same manner that one may observe the force of gravity exerted on objects. Throughout both the *Principia* and *Opticks*, a number of similarities arise between gravity and God. Newton's declaration of gravity to be a universal property of matter parallels his argument that God is universally present among all matter.

Newtonian theory became immediately popular after the publication of the *Principia* and prompted many scientists to follow Newton's objectives and research

methods. Frank Manuel discusses the popularity of Newton's work among his fellow scientists in *The Religion of Isaac Newton*. The works of Newton's followers, including men such as William Derham and Samuel Clarke, "advertised the superiority of Newton's system of the world as a religious apology above all other forms of Gloria" (Manuel 35). Newton did not discourage his supporters from writing such texts, but did not actively participate in the formation and publication of these works. On some occasions, he would comment on a work or theory that he felt was misguided or required a different perspective (Manuel 39). The primary objective for followers of Newtonian philosophy was to fuse science and scripture by pointing out similarities between the Bible and nature. As Manuel notes,

... scholars in Newton's circle, in their eagerness to demonstrate the consonance of the two books, embarked upon mammoth adventures in conciliation that eroded the wall between science and Scripture. They evolved what came to be known as *physica sacra*, a study of the history of creation as presented in Genesis and in the works of Newton, showing line by line the perfect harmony between them. The Book of Nature and the Book of Scripture were made congruent in every last detail. (37)

Newton's gravitational theory plays an essential role in the combination of natural science and Genesis. Although he claims the cause of gravity to be unknown, Newton suggests that a universal Spirit may be responsible for the force of gravity upon all objects. This allusion makes it possible for Newton's followers to insert God's involvement as an explanation for the attraction between two objects. Newton's analysis of the behaviour of

matter under the force of gravity offered new possibilities for *physica sacra* theorists to explain the occurrence of natural phenomena, such as the Universal Deluge, from the Creation narrative. William Whiston, one of Newton's supporters, incorporated astronomical gravitational theory into his own explanation of the Deluge. Whiston's primary theory proposed that 1700 years after the time of Creation, a comet passed near the Earth. He attributed this comet's gravity as the source and cause of the Deluge. While Newton did not necessarily approve of Whiston's theory, or his overly enthusiastic interpretations of the force of gravity, he did not publically dispute Whiston's publication. Manuel argues that John Woodward's *An Essay toward a Natural History of the Earth* was essentially forming in the same manner. Physical evidence of fossils uncovered in mines becomes evidence of Biblical accuracy and Newton's gravitational theory explains the distribution of heavier fossils in lower strata (38). From this further examination of Newton and his followers, it becomes evident that Woodward's fusion of scientific principles with Christian narratives was a mutual objective shared among many other scientists. Newton's significant advances in understanding natural laws provided a foundation for innovative ideas and theories about the fusion of science and religion. While these scientists attempt to prove the same biblical narratives by incorporating Newton's theories, they each approach this endeavour with individual and unique ideas, such as Whiston's comet theory. It is necessary for these theorists to put forth a unique hypothesis in order to ensure they receive credit for the discovery and there is no dispute over the origin of the theory. Woodward's inclusion of Newton's gravitational theory

reveals his participation in this larger cultural discourse and his aspiration to find a unique method of proving the occurrence of the Universal Deluge.

Only eight years after the publication of the groundbreaking *Principia*, Woodward uses this newfound principle of gravity to develop his theories of aquatic motion, fossil displacement, and strata development of the earth. Woodward's engagement with gravity reveals his understanding of current scientific thought and his desire to unite the most recent modern theories with ancient biblical texts. Woodward connects gravitational law to his main theory of fossil distribution, explaining how gravity is the primary cause for the particular locations of marine fossils in the strata:

The said Terrestrial Matter is disposed into the Strata or Layers, placed one upon another, in like Manner as any earthy Sediment, seething down from a Fluid in great Quantity, will naturally be: that these Marine Bodyes are now found lodged in those Strata according to the Order of their Gravity, those which are heaviest lying deepest in the Earth, and the lighter Sorts (when there are any such in the same Place) shallower or nearer to the Surface. (A3 v)

Woodward describes the settling of terrestrial matter as a constant and organized process. He specifically notes that particles settle by the *order* of their gravitational weight, suggesting that this is not a random process but follows scientific law. The separation of different sediments into layers, such as sand, soil or clay, is a process of categorization. Woodward argues that gravity groups similar particles together in the earth by weight, explaining the stratification of the earth. It is also significant that he claims this process is consistent around the globe. While Woodward is only able to observe the physical

locations of fossils in England, he verifies with “authentick Relations, that the marine Bodyes aforesaid are found in all Parts of the known World, as well in Europe, Africa, and America, as in Asia, and this even to the very Tops of the highest mountains” (Woodward A4). Woodward confirms the same observations are present in locations around the world, therefore convincing his readers that the settling of terrestrial matter by gravitational particle weight is a universal constant. However, he also indicates that one may only obtain this data from the ‘known’ world, which proposes that there is more to discover about the world in order to confirm this theory. Woodward reveals that there are limitations to the scientific method because of its reliance on factual proof. It is impossible to obtain or know all the facts about the world, which makes assumptions or guesswork a component of scientific discovery. While Woodward’s text proclaims to adhere faithfully to the Baconian method, it also recognizes the restrictions this technique places upon science. In order to produce a viable conclusion about the effects of gravity, this essay needs to transcend the Baconian method of basing science only on observed facts by assuming the gravitational force is constant throughout the globe.

Newton describes gravity as a universal law that organizes the motion, entropy and chaos in the universe (*Principia* 393). Woodward pushes this concept further by questioning whether the force of gravity acts by the mere tendency and disposition of matter, or whether it is the proof of a guiding force in the universe. Woodward connects the systematic gravitational separation of mineral deposits within the strata (including voids left by organic matter, thus leading to fossil formation) to the hand of God. He suggests that if scientists were to remove the possibility of God’s influence over the

motion of physical matter, this observable motion would instead happen by random chance. Woodward argues that in this scenario, “t’ would be no Wonder should [gravity] frequently *vary*: its Center swerve and shift, upon every turn: and that there should ensue thereupon, not only such Motions, and Alterations of the Bounds of the Sea as they imagine; but likewise many other, and not less pernicious Perturbations of the Course of even Universal Nature” (63-64). However, as Woodward notes, the force and direction of gravitational pull is constant and does not alter or change direction. The regularity of gravitational force opposes the chaotic tendency of particles in the universe and pulls all matter toward one central point. Woodward argues that the physical organization of the Earth, such as the boundary between sea and land, would not exist without the guiding force of gravity. Consequently, he uses the connection of gravity and its force on the Earth as evidence of divine influence:

But if the same mighty Power which in the Beginning produced this vast System of Bodyes out of Nothing, and disposed and ranged them into the most excellent and beautiful Order we now behold:... If that same Power be yet at the Helm: if it preside in the Government of the Natural World: and hath still the same peculiar Care of Mankind, and for their Sake... then may we reasonably conclude ‘twill also continue to preserve this Earth. (Woodward 64-65)

Woodward argues that God is responsible for the creation of our carefully ordered world out of the chaotic entropy of the universe. It is miraculous that random matter could appear from ‘nothing’ and be arranged into an order that supports life. He assumes the organization of the intricate world cannot possibly be due to the entropy of earthly matter.

Gravity guides and draws all matter to one central point, and therefore its force then serves as proof of God's existence. Woodward defines gravity as, "the Inclination of Bodyes towards a Center, to which Inclination they owe their respective Order" (63). Woodward's use of the word 'bodyes' refers to physical matter, but also doubles as an image of human bodies. He extends his definition of gravity to suggest that this guidance of matter to one singular point parallels the human desire to reach God, the central focus of Christianity. Woodward uses earthly phenomena as a direct confirmation of God's existence in his *Natural History of the Earth*.

Woodward further solidifies the connection between gravity and the presence of God by frequently quoting passages from the Bible in his analysis. The chapter fluidly shifts from a discussion of gravity's effects upon matter to the divine orderliness of the Earth. After discussing the mechanical properties and facts of gravity, Woodward states "so steady are the Purposes of Almighty Wisdom: so firm, establish'd, and constant the Laws, whereby it supports and rules the Universe... we have the highest security imaginable, that *While the Earth remaineth, Seed-time and Harvest, and Cold and Heat, and Summer and Winter, and Day and Night, shall not cease*" (65-66). This statement suggests the gravitational law, established by Newton, reflects the purposes of God and participates in the ruled order of the universe. Through observing discovered scientific laws, such as gravity, God's presence in the universe is evident. Woodward chooses to quote Genesis 8.22 to support his argument. He uses these Biblical citations as a form of literary rhetoric to persuade his readers of the truth of his claims. This particular line reflects the seasonal changes of the Earth and the inherent cyclical nature of these

changes. As the force of gravity is consistent, it serves to maintain the order of the Earth, securing and protecting human life.

Although Woodward uses the Universal Deluge, a singular phenomena and significant interruption of earthly order, as initial proof of God's existence, he focuses on the consistency of gravity as evidence of the continual presence of God on Earth:

[Gravity] does not proceed from the Efficiency of any such contingent and unstable Agents, but stands on the Basis more firm and steadfast; being entirely owing to the direct Concurrence of the Power of the Author of Nature, immediately in his Hand, and the main Engine whereby this stupendous Fabrick of the Universe is managed and supported: the prime Hinge whereon the whole Frame of Nature moves: and is principally concerned, if not the sole Efficient in the most remarkable Phenomena of the Natural World; which, should Gravity once cease, or be withdrawn, would instantly shiver into Millions of Atoms, and fall into the greatest Disorder and Confusion. (Woodward 56-57)

Woodward suggests gravity to be the most essential natural law to the existence of the Earth. Without this force, all worldly matter would descend into chaos and the world would cease to exist. It is essential that Woodward view this world as active and moving, but that these motions do not occur at random. A stagnant Earth would require no maintenance or care, while a world that has specific laws of motion must necessitate continual attention. Furthermore, Woodward argues that gravity is a constant force: "That the common Centre of Gravity in the Terraqueous Globe is steady, immoveable, and not liable to any accidental Transposition: nor hath it ever shifted or changed its Station"

(57). Woodward's assumption that the force of gravity has never changed location violates Baconian methodology, as he is unable to verify that this force has been constant since the time of Creation. However, Newton's calculation of gravitational force and Woodward's personal observations of this effect allow him to conclude that gravity has been constant since the time of Creation.

Woodward attempts to appease both the ancients and the moderns since he claims to prove his hypothesis with both scientific and Christian evidence. While the heuristic inclusion of Biblical references contradicts his supposed Baconian methodology, it allows Woodward to establish a significant link between religion and science. He suggests that gravity duly functions as both a scientific law for the motion of bodies on Earth and physical proof of God's existence. Furthermore, this opens the possibility that all natural laws point to the power and influence of the divine.

Conclusion

The Results of Woodward's Natural History

Woodward intended to unite natural philosophy with theology in his *Natural History of the Earth*, confirming the existence of God and His omnipotence by proving the occurrence of the Universal Deluge with physical evidence from the Earth. While Woodward claims that his data undoubtedly proves the reality of the divine, he does not address the ramifications of confirming God's existence in this manner. Although the Biblical narrative of the Universal Deluge describes the flood as God's purposeful obliteration of humankind, Woodward chooses to divert his readers away from the violence of the flood. His text rarely discusses the flood as a consequence of God's frustration with his people, but rather as an indication of His power, maintenance and control over the Earth. The structure of Woodward's *Natural History* encourages his readers to understand God as a benevolent Being, and that His presence ensures the continuation and protection of the natural order of the Earth. However, Woodward's conclusion that the Universal Deluge is physical proof of divine intervention reveals something about the nature of God. This conclusion indicates that God is capable of destroying his Creations, both physically and morally. A wrathful God threatens the stability of the Earth that Woodward diligently attempts to prove. The occurrence of the Universal Deluge also defies the natural laws that, Woodward argues, protect the present state of the Earth. While Woodward maintains these natural laws provide consistent order on Earth, such as the force of gravity and the behaviour of minerals, the occurrence of the Biblical flood would prove that natural laws do not always apply. These laws do not

confine God's power, thus leaving the future state of the Earth subject to His whim.

Woodward briefly addresses this issue by referring to God's declaration in Genesis that He would never again smite the Earth:

But further, *Gen. viii. 21,22. And the Lord said in his Heart, I will not again curse the Ground, - neither will I again smite any more every Thing living as I have done. While the Earth remaineth, Seed-Time and Harvest, and Cold and Heat, and Summer and Winter, and Day and Night, shall not cease.* This was pronounc'd upon Noah's Sacrificing, at his coming forther of the Ark, after the Deluge was over: and implies, that there had indeed then lately been a mighty Confusion of Things, for the Time: an Interruption and Perturbation of the *ordinary course* of them: and a Cessation and Suspension of the Laws of Nature: but withal gives Security and Assurance that there should never be the like any more to the End of the World... (Woodward 303-304)

While Woodward uses this passage as evidence that an interruption of natural law will never occur in future, he does not attempt to theorize how these physical laws could have possibly been suspended at the time of the Universal Deluge. He frequently avoids similar complex questions, which renders his work problematic at times. While Woodward attempts a seamless union of theology and natural philosophy, his avoidance of these questions proves this task is more difficult than he admits.

These contradictions present in Woodward's *Natural History of the Earth* prompted criticism from some of his colleagues and other natural philosophers at the time of its publication. One of Woodward's most ardent critics was John Ray. Woodward and

Ray maintained a number of conflicting theories about fossils, and neither man respectfully acknowledged the ideas of the other. Ray took particular issue with Woodward's dismissive attitude toward his own work and the work of others. In the *Natural History*, while he includes descriptions of fossil theories by other learned men, Woodward also makes it very clear that these ideas are wrong. Furthermore, he promises to provide insight into these errors while offering a clear and accurate understanding of fossils in nature:

Why I adhere to them who suppose these Marine Productions brought out by the Universal Deluge, will be best learn'd from the succeeding Part of this Essay, which is wholly dedicated to that Purpose. And to that I shall prefix an Historical Account of the Labours of Fab. Columna, Nic. Steno, P. Boccone, Jac. Grandius, Mr. John Ray, and other Learned Men, on this Subject; shewing what they have already done in it, wherein they *failed*, and what remains still to be done.

(Woodward 42)

Woodward's blunt attitude towards others' 'incorrect' theories makes him a perfect target for hostile responses from his contemporaries. Ray's direct criticism of Woodward emerges in his letters to Edward Lhuyd, a fellow naturalist and member of the Royal Society.

As for Dr. Woodward's *Hypothesis*, if he had modestly propounded it as a plausible conjecture, it might have passed for such; but to goe about so magisterially to impose it upon our belief, is too arrogant & usurping. I cannot but wonder to find such a strain of confidence & presumption running through his

whole book that he should be so highly conceited of an Hypothesis for wch he hath no other proof but a negative one, I mean, that those bodies must by this means be thus lodged & disposed, because they could not possibly be so otherwise. (Ray 256)

Ray notes that a significant part of Woodward's work focuses on disproving the theories of other natural philosophers. Woodward is unable to prove his hypothesis with only evidence and data, and must rely on the elimination of other plausible theories to make his own seem more accurate. Perhaps Ray's criticism indicates a fatal flaw in Woodward's work that prevented his theories from becoming as popular as Newton's gravitational theory. Although Woodward offers some significant ideas and evidence in his essay, he does not successfully prove the occurrence of the Universal Deluge beyond any doubt. His dismissal of other theories, while necessary in order to promote the validity of his hypothesis, tends to seem arrogant when he is unable to fully explain and indisputably prove his own theory. Ray, alongside many of Woodward's other colleagues, notices this conceit in the *Natural History of the Earth*. In the same letter to Edward Lhuyd, Ray continues to question Woodward's ability as a natural philosopher.

I shall not further censure it, only give you my very good friend Dr. Robinson's opinion of the Author & his Work. He writes (saith he) with a high hand, unbecoming his station & character, & shows too much ostentation... He pretends to have compared ye Old and New world in every particular, but in discoursing with him I discover his ignorance in ye History of both... His motion of Gravity is ridiculous... I wonder how his shels should sink lower then metals in ye great

Fluid, or how the whole Fossil part of ye Globe should be dissolved in ye Deluge when as the Animal & Vegetable remained entire & untouched. But the revealing of these secrets he reserves for his greater Work, to set us alonging for the publication of it. (Ray 256-257)

Ray does not limit his criticism to the effectiveness of the essay, but also targets Woodward's character and intelligence. He specifically draws attention to Woodward's social class and education. Woodward's status as a man with a lower social station and without a formal university education was problematic for him among his critics. At this time, only men who could afford to spend a large amount of time researching and collecting data became scientists. Critics challenged the validity of Woodward's theories because of his social class and lack of established wealth. Woodward continuously battled this prejudice in his chosen discipline. It is clear that Woodward's arrogance is also a source of significant aggravation for his colleagues of natural philosophy. This passage also reveals that the contradictions and deficiencies in his essay were extremely noticeable to his peers. Ray suggests that Woodward may have purposefully left out some of his evidence as a design to sell more copies of his next work. His promise to reveal further details not present in the original essay in a subsequent, larger text serves as an advertisement to entice readers to read his next publication. Ray's evaluation of this method reveals that the process of publishing scientific data was a primary concern among followers of the 'new science'.

Physician and satirist John Arbuthnot was another significant critic of Woodward's scientific method and publications. He became a member of the Royal

Society in 1705. The height of Arbuthnot's political and satirical importance began with the accession of Queen Anne to the throne in 1702, and fell with the accession of George I. Arbuthnot published numerous 'anti-Woodward' pamphlets that criticized his work as a natural philosopher. He also helped produce the farcical comedy *Three Hours After Marriage* alongside two famous English satirists, John Gay and Alexander Pope. This comedy premiered onstage in 1717 and satirized many public figures. The principle satirical character, Dr. Fossil, was a representation of Woodward.

In 1697, Arbuthnot participated in the controversy over the Biblical flood, specifically analysing Woodward's argument in *An Examination of Dr. Woodward's Account of the Deluge*. Like Ray, Arbuthnot focuses on identifying contradictions and logical problems in Woodward's *Natural History of the Earth*:

[Woodward] has baulk'd our Expectation in the most material Points; viz. What brought the Water of the Abyss upon the Surface of the Globe? What succeeded in its room? What dissolv'd the Fossils? And at the same time spared the Animal and Vegetable Substances?... All these the Doctor has tickt for; putting us off at this time only with the Reason why the Strata ranged themselves in their present order; viz. the different Gravity of the Matter whereof they consist. I wish at the same time he had not told us things of less moment. (8)

Arbuthnot notes many of the issues and absence of evidence that other critics observe in Woodward's text. However, he also critiques Woodward's exhaustive Baconian method. Arbuthnot disapproves of the exhaustive inclusion of many details that do not directly relate to Woodward's objective of proving the occurrence of the Universal Deluge. While

Arbuthnot argues that the *Natural History* includes too many irrelevant facts, he also believes it also leaves out important factors or theories. Conversely, Arbuthnot particularly values Nicolas Steno's fossil theory for its mathematical structure and Steno's reputation as a widely recognized as an expert on fossils and theories of the Deluge. Therefore, Arbuthnot finds specific instances where Woodward's text deviates from Steno's ideas, such as the size difference between existing shells and fossilized shells. While Woodward argues the size of the shells do not differ from the living to the fossilized, Steno points out the noticeable size discrepancy. The clear size difference hinders Woodward's argument because it seems as though he is tailoring his findings to his desired conclusions. Arbuthnot points out that most noticeably, "the difference between the Doctor and Steno in this particular is, That though Steno admits the Deluge as one [explanation], he does not with the Doctor exclude other partial Agents, as Inundations by Earthquakes, &c." (46). He finds fault with Woodward's essay for its dismissal of other possibilities and theories.

Arbuthnot prefers a mathematical approach towards natural history, which explains his affinity to Steno's work. He finds mathematics most useful because of its ability to free the mind from prejudice and superstition (Ross, "Arbuthnot, John (*hap.* 1667, *d.* 1735)"). Arbuthnot notes many mathematical errors in Woodward's essay, such as the ratio of fluids to solids in Woodward's calculation of the Universal Deluge. While Woodward argues that there is enough water present on Earth to dissolve all the solid masses, Arbuthnot refutes his claim because mathematical calculations prove this

dissolution impossible. Arbuthnot continues to find other examples in Woodward's text that defy natural law and logic.

But the strangest thing, and, if I may so speak, the Miracle of all Miracles is, that the Water and Solid Matter now mixt together, should either float upon a Vacuum, or the Subtil Matter that came in place of the Water of the Abyss... This is turning Nature outside inward; the Bottom of the Ocean is now supported by Water, and the Water by the Air. Well, if the Dr. gives a Reason for this too, adieu Hydrostaticks. (17)

Arbuthnot refers to hydrostatic pressure, which is the pressure a fluid exerts in an equilibrium state by the force of gravity. The only force acting on water particles at the bottom of a container is the force of the water above it. Arbuthnot understands that Woodward's theory would require water to float upon the vacuum of the interior abyss, which is not a logical or mathematically possible conclusion based upon hydrostatic law. Arbuthnot's discussion of the *Natural History* reveals his frustration that this work conflicts with too many other theories to be plausible.

Dr. Woodward's Hypothesis seems to be liable to many just exceptions, the whole is not to be exploded... Yea, some there are so fond of an Opinion, that they will take pleasure to cheat themselves and would bring every thing to fit their darling Hypothesis. Then only we may expect to succeed in compiling of Theories, when we build upon true and decisive Observations; and survey the Works of Nature with the same Geometry (tho in a more imperfect Degree) by which the divine Architect put them together. (62-63)

Arbuthnot suggests that Woodward should adjust his Baconian scientific method to a more logical process. This criticism reveals that the scientific community is slowly modifying the Baconian method. He concludes that a good natural philosopher must sift through all of the material available and decide what information is crucial and necessary to include in a scientific paper. This process would eliminate unnecessary, overwhelming information that does not directly help prove a hypothesis and in fact, hinders the reader's understanding of the argument. However, Arbuthnot also determines that it is equally destructive to a scientific hypothesis to ignore crucial information. Leaving out data in order to prove a particular theory compromises the integrity of scientific discovery. Arbuthnot's concern is that Woodward is including information that does not clarify his hypothesis but also ignoring data that could potentially disprove his hypothesis entirely. However, Arbuthnot's critique of Woodward's essay is significant as it reveals a mutual desire among followers of the 'new science' towards a better, more selective scientific method.

While the reciprocal belittlement of scientific theories among these men may seem destructive to the 'new science' endeavour, mutual criticism among all scientists of the seventeenth and eighteenth-centuries was essentially a productive process. The criticism of Woodward's text by his contemporaries reveals that Woodward was participating within a scientific network, ultimately connected to his peers because of their mutual objectives. The goal of these natural philosophers is to successfully discover and confirm a natural law, which their peers cannot refute. Proving such natural phenomena offers fame and an intellectual reputation in the scientific world. Woodward

is working with the understanding that his ideas affect the theories of other natural philosophers. Therefore, his peers will be closely examining his work and striving to prove their own theories are more accurate in order to claim superior knowledge of the subject. This scientific discourse challenges theorists to be accurate in their conclusions and find sufficient evidence to support their claims. The fusion of innovative ideas with previously established theories makes a hypothesis more credible to the scientific community and allows the scientific discipline to build upon its own foundations. This process of peer reviewing, although it rejects many theories, successfully drives science forward and encourages scientists to be accurate in their publications. While Woodward's peers find his essay to be frequently problematic, many do admit there is credibility to some of his conclusions and data. Other natural philosophers in England and abroad defended Woodward's ideas and methods. Ultimately, the reviews of Woodward's essay function to provide a foundation upon which he can improve his scientific method and natural philosophy in future.

Woodward did not noticeably apply any of this criticism to his work on the Universal Deluge. After his publication of the *Natural History of the Earth* in 1695, he mostly turned away from writing about the occurrence of the Biblical flood. Woodward chose to focus his efforts on collecting curiosities: fossils, geological specimens, and antiquities. His next publication, in 1696, was titled *Brief Instructions for Making Observations in all Parts of the World: As also for Collecting, Preserving, and Sending over Natural Things*. In this text, Woodward develops rules for collecting objects and specimens in many different environments: at sea, on the sea-shores, and at land.

Woodward's primary rule is to keep a journal on hand to record all observations of the environment and objects, therefore returning to a Baconian style of exhaustive examination and documentation. As David Price has shown, Woodward's Baconian attitude toward a systematic collection of specimens, alongside his abilities as a curator, cataloguer and interpreter of his own geological collections, establish him as a pioneer of modern scientific practice (79). Woodward applies these rules to the rest of his literary works and his personal collections of curiosities. This publication also served as a guide for the collection of geological specimens by his collectors and his guidelines remain difficult to improve on. Woodward's text offers significant structure to the practice of curation and museology (Levine "Woodward, John (1665/1668-1728)").

The practice of collecting was widespread in England among wealthy members of society and was especially popular among members of the Royal Society. As P. Fontes argues, the Society and its members often displayed collections of natural curiosities at meetings. The purpose of these exhibitions was to promote inquiry, education, polite discourse and entertainment among the Fellows (147). The Royal Society maintained its own collection of curiosities and rarities, but many of the members had their own personal collections. Hans Sloane possessed the most celebrated personal collection within the Royal Society, which formed the foundation of the creation of the British Museum (Fontes Da Costa 149). Collections by Martin Lister, Ralph Thoresby and Woodward were also well known among the Fellows. The opportunity to display natural curiosities at the Royal Society meetings functioned as a method for the Fellows to advertise their personal collections and gain a reputation for being a knowledgeable

collector. The Society itself also offered a way for members to collect different specimens from around the world. Some Fellows and correspondents of the Society residing in the British colonies would send natural and artificial curiosities back to England. This explains Woodward's ability to gain specimens from around the world without leaving the country. Woodward had many travelling and over-seas correspondents such as diplomats, merchants, and captains and surgeons of ships. Woodward acquired many natural curiosities from his connections, and his exchanges with other collectors further increased the size and scope of his collection (Price 81). Woodward also amassed another large collection of foreign artefacts, including Egyptian antiquities, and his catalogue of this collection, *Archaeologia*, was published posthumously in 1776. As Woodward believed geological specimens could help determine the history of the physical Earth, he similarly thought antiquities could help modern scholars reconstruct the early history of humans on Earth (Levine, "Woodward, John (1665/1668-1728)").

Woodward's collections include natural and artificial curiosities but his primary interest is geological specimens. Price argues that Woodward was, an avid collector of antiquities – statues vases, inscriptions, amulets – and a great bibliophile. Even here, though, there is evidence that he was a more discriminating collector than many. For instance, though there were at the time the objects most prized and sought after by collectors in general, Woodward's collections when they came to auction contained no coins or medals... It was the 'fossils' that were his great and lasting preoccupation, their accumulation forming a major part of his life's work. (80)

His collection of geological objects included ‘native fossils’ (minerals and rock) and ‘extraneous fossils’ (the modern understanding of fossils). He collected his first geological specimen in 1688 in a gravel-pit at St. James’, and his first fossil in 1689 in the stone-quarries around the Shelborne estate of Sir Ralph Dutton (Price 81). Woodward personally collected natural specimens during his fieldwork around England before he settled into his professorship at Gresham College. An interesting aspect of Woodward’s collection process is that he does not confine his collections to rare or particularly valuable pieces. He desired the assortment of objects to be comprehensive and representative of what exists in the real natural world. As Price states, Woodward believed that men should first understand the common aspects of the Earth before attempting to engage with the rare or obscure (80). He acquired many other pieces for his collection through donations from correspondents overseas, purchasing specimens from other collectors, and employing other people to travel around England on geological expeditions to collect more specimens. Woodward’s collection grew to a remarkable size. In 1705, a record notes Woodward’s collection contained over 1700 English specimens. By the end of Woodward’s collecting, he had amassed 6837 English and 2550 foreign specimens, 9377 pieces in total. His employees’ collections helped to supplement this massive collection, but Woodward continued to collect geological specimens personally when it was possible for him to go on expeditions outside of Gresham College (Price 82).

Woodward maintains a Baconian style in the cataloguing and classification of his collection. He began cataloguing his specimens immediately after he started collecting and specifically divided the foreign material from the English material. Woodward

arranged the objects physically, and in his catalogues, with a complicated classification scheme. He separated his material into four categories: English Native, English Extraneous, Foreign Native, and Foreign Extraneous. As his collection grew, it became increasingly difficult to insert and organize additional pieces. His initial strategy was to leave gaps in the numeric sequence so that additions could be placed in the appropriate category, but this method could only accommodate a limited number of additions. He ultimately decided to create new, separate catalogues under the four main sections of his collection. The original catalogues and the additional catalogues totalled twelve volumes by the end of his life, organizing Woodward's entire geological collection (Price 83). Each of the four collections reside in individual wooden cabinets. His original collection of English fossils are contained in the first two cabinets, marked A and B. His additional English fossils are in cabinet C, while the foreign fossils are in cabinet D. Woodward focussed the remainder of his life on collecting and organizing his geological specimens. Upon his death in 1728, two of his works were published posthumously. *Fossils of All Kinds Digested Into a Method* further revealed his views on the classification of fossils, while *An Attempt Towards a Natural History of the Fossils of England; in a Catalogue of the English Fossils in the Collection of J. Woodward, M.D.*, is the two volume set of Woodward's entire collection catalogue (Levine, "Woodward, John (1665/1668-1728)"). In his will, Woodward donated his first two cabinets of his original English fossils to the University of Cambridge. The University purchased the two remaining cabinets when they became available in auction. Woodward's collection and original manuscript

catalogues remain remarkably intact and survive today in the Sedgwick Museum, Cambridge (Price 83).

Woodward wrote about the Universal Deluge very few times after his original publication of the *Natural History of the Earth*, choosing instead to focus on his collecting and Baconian methodology. In 1712, Elias Camerarius, a German physician, challenged Woodward's Deluge theory once again. Woodward responded to this attack in 1714 with a Latin essay, *Naturalis Historia Telluris*, in which he explains how the dissolution of the Earth was possible because of a divine suspension of gravity during the time of the Universal Deluge (Levine, "Woodward, John (1665/1668-1728)"). Woodward has little physical evidence to support this modification of his original argument and does not enthusiastically pursue this particular hypothesis further. In 1726, John Holloway translated this text into English. Holloway's notes indicate that Woodward published another work titled *A Representation of the State of Mankind in the First Age after the Deluge*. This work has since been lost, but Holloway's description of the work indicates that it focussed on the Mosaic narrative in a similar fashion as the *Natural History of the Earth*. However, Holloway claims that Woodward used the methods of modern anatomy and biology to confirm the truth of the Biblical narrative. If such a work existed, it indicates Woodward's attempt to unite all the modern sciences with Christian theology, and displays his desire for all scientific discoveries to become validation of God's existence and divine influence. Woodward's infrequent pursuit of this theory reveals his reluctance to venture too far into a speculative and controversial topic. While Woodward seemingly abandoned his endeavour to prove the flood's existence, these occasional

returns to Biblical narratives in his work reveals that he was continually thinking about the fusion of natural and theological history throughout the remainder of his life.

The Significance of Woodward's Work

Woodward's *Natural History of the Earth* drew a significant amount of criticism and controversy within the scientific community in the late seventeenth and early eighteenth centuries. The contradictions and errors in this text meant Woodward was satirized by his peers, and largely ignored by modern scientific historians. Presently, his geological collections are considered his greatest contribution to science, while his writing remains vastly overlooked. With so many issues in his scientific writing and methodology, it may seem unclear why the *Natural History of the Earth* deserves a reassessment of its contributions to the 'new science'. The primary significance of Woodward's essay is that it provides a window into the state of science in late seventeenth-century England. Woodward discusses many current scientific theories, with references to contemporary publications of his colleagues. This reveals which works were influential among members of the Royal Society. Woodward's essay is unique as it combines a great number of individual theories in order to reveal the overall understanding of a concept. His combination of fossil theories by Ray, Steno, Hooke and himself demonstrates a larger and comprehensive understanding of fossils than would be possible by only examining one of these theories. Woodward's inclusion of many different theorists and their hypotheses reveals the complex network of the scientific community during this period. Natural philosophers competed with one another, racing to be the first to discover and explain natural phenomena. These men frequently interacted

with one another, debating new theories and disputing the ideas of their opponents. This competition is evident in Woodward's essay as he explains the hypotheses of his rivals and then attempts to prove them wrong or inaccurate.

The *Natural History of the Earth* is also significant for Woodward's display of Baconian methodology, and equally for his deviation from this method. His claim that he will remain an objective and methodical observer reveals the desire for structure. His use of Baconianism many years after the publication of the *New Organon* indicates Bacon's impact on the practice of collecting and recording scientific data. A clear scientific method, including the recording of observations and findings, became a requirement for theorists to provide believable evidence in support of their discoveries. However, Woodward deviates from Baconian methodology by speculating and hypothesizing about his findings, while incorporating Biblical passages into his work as evidence. While physical observations remain of primary importance in Woodward's essay, the combination of these observations with logical hypotheses and speculations reveals the beginning of a new scientific process, one that closely connects to the modern scientific method.

While Woodward's inclusion of Biblical narratives and discussion of God's omnipotence is scientifically problematic from a modern viewpoint, this fusion of science and theology is extremely significant. This synthesis documents a moment in scientific history where theorists were negotiating a rapidly expanding scientific knowledge and the traditional, revealed knowledge of the Bible. Woodward is one of the few men who fully participated in the discipline of physico-theology and this work clearly suggests the

possibility of understanding God's spiritual presence through interaction with the physical world. While no scientific theory has yet proven a direct connection between the physical Earth and God's existence, neither does it remain impossible. Woodward's *Natural History of the Earth* draws attention to the complexities and perfection of the Earth, and encourages his readers to find evidence of divine influence in the most common places. He enables the reader to view the entire Earth as a physical manifestation of God's presence. Woodward's ability to reveal the world as a beautiful, intricate, chaotic, and yet ordered place is not lost on the modern reader.

Woodward's catalogues and collections are an unrivalled source of information and remarkable insight into the state of 'terraqueous' knowledge in the late seventeenth- and early eighteenth-century. However, the *Natural History of the Earth* is also a significant piece of scientific history for its detailed documentation and its fusion of current scientific theories of various early modern scientists. His desire to prove the physical occurrence Universal Deluge is remarkably productive as it encourages him to push the boundaries of his own knowledge and pursue innovative methods and hypotheses. Woodward literary work offers a unique view of the Earth, finding God in all environments and physical forces. This essay gives exceptional insight into the knowledge and practices of early modern science, and should be recognized as a fundamental text in understanding the progression of knowledge and the interaction of science with theology.

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