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MYTH AND REALITY: MEDIEVAL SCIENTIFIC THOUGHT

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ABSTRACT

Some commentators admit that there is constant conflict between science and theology. The reason they put forward is that metaphysical concepts cannot be linked with empirical sciences. Despite such a theoretical background, many commentators claim that the Western Medieval period has no scientific significance. If their claims are true, science and scientific research should have completely stagnated after the Greek period, and the renaissance of science should have come again with the Copernican revolution. Are these reviews true? Or a myth? The fact that there are some problematic conditions here is evident from the works related to the investigations of the Middle Ages. Therefore, through this article, I attempt to explain the form of medieval scientific thought. It can identify the relationship between medieval theology and scientific thought, as well as the collapse of science due to theology. A more recent period of human thought spans almost 17 centuries, spanning almost the period of medieval scientific thought. Therefore, instead of investigating the above objectives in detail, it is important to focus on important milestones. As this study should be conducted within the framework summarized above, what was the contribution of medieval theological thought to the advancement of science? Is that scientific thinking acceptable? Are the criticisms presented in this regard acceptable? It can be explored through research questions, etc.

KEYWORDS:- Greek thought, medieval, science, scientific thought, theology.

1. INTRODUCTION

The conflict between science and theology is a common teaching found in many works. It is also true that philosophy teaches that there is a fundamental conflict between science and Christianity in particular. But in truth, it is necessary to examine whether such a situation existed between religion and science, especially in the Western Medieval period, when Christianity began and spread powerfully. A period in which Christianity became the cultural force was to be characterized by the stagnation, decline, or absence of science. When investigating contemporary analyses in this regard, it should be possible to see such a basis even today. If that is the case, according to the modern world view, the limitations that should be built into Western medieval scientific thinking and how they can be accepted should be examined. Accordingly, the fundamentals of scientific thinking

should be examined. Here it is important to focus primarily on the early form of medieval thought, the beginnings of universities, translational movements, and the form of medieval scientific thought and scientific discoveries.

2. RESEARCH METHODOLOGY

The primary methodology of this study is the literature-based analysis method. Focusing only on early medieval phenomena, it is necessary to refer primarily to the documents presented in this regard. It does not deal directly with these issues but indirectly accesses information from various publications, commonly referred to as the "unrelated method." Furthermore, such studies should fully share information. However accurate information cannot be identified from a single source. Therefore, the information presented by the sources must first be checked using the comparative method, and through that, the correct knowledge should be explored. This study is based on that.

3. ARGUMENTS HAVE BEEN MADE THAT MEDIEVAL THOUGHT LACKS A SCIENTIFIC BASIS.

Nicolaus Copernicus (1473–1543) is recognized by many writers as the pioneer of modern scientific thought. He received this recognition due to his scientific handling of thought toward heliocentrism, discarding the earth-centrism that existed until then(Grant, 1962). This foundation has been accepted by many commentators as a rejection not only of Christian theology but also of Aristotelian teachings.

Although the initial basis is the same, that form is best reflected in the basis presented in relation to medieval science in the present context. Authors such as these are of the opinion that it is natural to assume that there was no scientific progress in the Middle Ages because the achievements of science in that period were not so well known. Some writers use the adjective medieval as a synonym for barbarism and immoral behavior.

- The words medieval barbarism and vulgar behavior are associated with the Taliban in Afghanistan, says James Hannam. Commentators describe these events as a return to the Middle Ages, if not the Dark Ages(Hannam, 2009).
- Daniel Boorstin, in his History of Science, called the Middle Ages the great obstacle to human progress (Boorstin, 1983).
- William Manchester described the medieval period as one of constant warfare, corruption, lawlessness, an obsession with strange myths, and an almost invisible mindlessness (Manchester, 1992).
- Charles Freeman points out that this age was a period of intellectual stagnation. He went on to say that it is difficult to see how mathematics, science, or related subjects could have made any progress in this environment (Freeman, 2002).

4. THEORIES ADVANCED ABOUT THE NATURE OF MEDIEVAL SCIENCE.

However, the question of whether the medieval period was really an era devoid of scientific thought does not arise when consulting such reviews, but when considering the formal investigations of medieval science. John Hadley Brook and Ronald L. Numbers show that medieval scientific

thought was dominated by three theories of the relationship between theology and natural philosophy during the seventeenth century (Brooke & Numbers, 2011).

- The first theory is that such a situation has arisen because there is a lack of historical evidence. John Gerard Yegge argues that science has continued to flourish, that Christianity has been the enemy of science throughout its history, and that it has consistently erected theological barriers to scientific progress (Yegge, 2009). He adds that examples such as Galileo's trial and various episodes of medieval conflicts are regularly presented as cases. John Brooke and Ronald Numbers point out that these facts were presented as myths during the French Enlightenment in the 18th century. John Hadley Brooke and Ronald L. Numbers indicate. John W. Draper and Andrew Dixon White Through popular books in the 19thcentury, these facts became the sole basis for anti-Christian Science and continue to develop even today (Draper, 2009).

- The second theory has been advanced due to the dominance of the writings of relatively small scholarly elite in the 2nd century. Reijer Hooykaas has tried to show that they only used Christianity and Christian theology to maintain order and to provide basic assumptions to those concepts and that in some cases, biased religious motives motivated followers to exclude science (Hooykaas, 2000). He mentions that the rationality necessary for the development of modern science is formed by it.

- The third theory explains that there is recognition that there is a more complex relationship between Christianity and science. Philipp Frank points out that it explains why medieval Christianity exhibited encounters with both opposition and encouragement of science and scientific inquiry (Frank, 1952). Carey Lynn Thigpen shows that there was a pattern of interaction that powerfully shaped both Christian theology and Christianity without favoring the natural sciences (Thigpen, 2020).

5. MYTHS BETWEEN CHRISTIAN THEOLOGY AND SCIENCE ACCORDING TO MODERN SCIENTIFIC THOUGHT

The greatest myth in the history of science, Christian theology, is that they were in constant conflict. To promote this concept, Ronald L. Numbers cites nineteenth-century American works, Andrew Dixon White's ‘The Battle - Fields of Science’ (1869) and John William Draper's ‘History of the Conflict between Religion and Science’ (1874) (Numbers, 2010). White has tried to show that there was a war between science and religion. He wrote ‘History of the Warfare of Science with Theology in Christendom’ (1896), which included Giordano Bruno (1548-1600) being burned alive as an ungodly monster, Galileo being tortured and humiliated as the worst infidel, and much more. Elizabeth Cady Stanton, on whom this book is based, has shown that the Bible is the greatest obstacle to the progress of science (Stanton, 1897).

George Frederick Holmes (1820-1897) has shown that the struggle between science and religion, as well as between philosophy and faith, has a centuries-old history. However, it has been further pointed out that it was declared irreconcilable by many in the 19th century (Holmes, 1851). John Rickards Betts says that Charles Darwin's book ‘On the Origin of Species’ (1859) also influenced

this foundation (Betts, 1959). Irish Physicist John Tyndall's (1820-1893) book 'Fragments of Science' pointed out that the whole cosmological theory must be removed from theology and that religion cannot be derived from it as it is really useless and meaningless (Tyndall, 1889).

Thus, Ronald L. Numbers points out that 19th-century scientists such as White, Draper, Stanton, Holmes, and Tyndale turned to master myths to achieve their foundations (Numbers, 2010). He further explains in 'Galileo Goes to Jail and Other Myths about Science and Religion' that the following myths exist between theology and science discussed today. Like the myths of Bruno (Shackelford, 2010) and Galileo(Finocchiaro, 2010) mentioned above, that the rise of Christianity was responsible for the demise of ancient science (Lindberg, 2010), That medieval Christians taught that the earth was flat(Cormack, 2010), that the Medieval Christian Church suppressed the growth of science(Shank, 2010), that the Medieval Church prohibited human dissection(Park, 2010), that Christianity not gave birth to modern science(Efron, 2010), That the scientific revolution liberated science from religion(Osler, 2010), That Catholics did not contribute to the scientific revolution (Principe, 2010),that Isaac Newton's mechanistic cosmology eliminated the need for God(Davis, 2010), that the Church denounced anesthesia in childbirth on Biblical grounds(Schoepflin, 2010), that evolution destroyed Darwin's faith in Christianity—until he reconverted on his deathbed(Moore, 2010). The belief that Christianity was destroyed until now has been proven wrong.

6. THE COLLAPSE OF GREEK SCIENTIFIC THOUGHT

Modern science highly acknowledges that the foundations of scientific thought were built on the discoveries of Greek scientists. But it may be pointed out that Greek thought is the general meaning of the whole. The scientific studies of philosophy in mathematics, astronomy, topographical studies, medicine, navigation, and engineering fields began with the scientific thinking of the ancient civilizations of Mesopotamia, Egypt, India, etc(Lindberg, 2007). Greek Science is a combination of all these. Hence the teaching of St. Clement of Alexandria (150–211/215) that scientific thought is not entirely Greek (Ferguson, 2005). However, the formal beginnings of scientific thought were established through the studies of Greek scientists (Ferguson, 2005). Greek scientific thought has been created through Greek scientific logic (Waterfield, 2018). Thales, the founder of the philosophical thought known as the Scientific Revolution, dispelled myth by realizing that the universe and the world were knowable. He explained that one can use one's mind to conclude because of the study of observable phenomena rather than the desire for supernatural beliefs(Mark, 2023). Thus, scientific thinking, starting with Thales (624/620-548/545), spread through the investigations of Greek philosophers. Aristotle (384–322) laid its unique foundation.

However, by the beginning of the Middle Ages, classical Greek scientific thought had suffered a serious decline. It is important here to examine why Greek scientific thought, which was in such a high position, suffered a collapse. It may be mentioned that scientific studies in ancient Greece were rejected due to several reasons.

1. Aristotle studied at the Lyceum under the patronage of Emperor Alexander the Great (356-323). However, after the emperor's death, Aristotle could no longer stay in Athens, so he had to

escape from Athens. After that, scientific research at the Lyceum gradually collapsed due to the denial of state patronage (Chroust, 1966).

2. The political and social instability during that period can be identified as the next reason (Hughes, 2022). Succession problems led to the capture of Babylonia by the Macedonians within 48 hours of the emperor's death and the gradual disintegration of power in Greece.
3. Another reason is the shift in emphasis to empirical scientific inquiry due to the rise of ethical philosophy and its focus on abstract reasoning.[1]
4. The lack of patronage for scientific activities and the absence of formal institutions for scientific research also affected the gradual decline of scientific studies during that period.[2] This fall was at its most prolific by the beginning of the Middle Ages.
5. Because the astrological knowledge brought from the East by Emperor Alexander the Great was not the same as Greek thought, the confusion between those thoughts and the conflicts between the more correct things were a powerful influence (Clarke, 1962).
6. The present acceptance that there was no Hellenistic scientific age, which did not exist in Greece but provided new interpretations in the 19th century, should also be understood here(Chaniotis, 2010).
7. Greece's submission to the Roman Empire laid the groundwork for the rejection of Greek scientific thought. Because of that, Greek science and philosophy were relegated to a low status (Britannica, 2024).
8. With the flourishing of the Roman Empire, the Greek scientific foundation rapidly vanished out due to the independent establishment of medicine, astrology, astronomy, engineering technology, art, architecture, technology, literature, language, and law.[3]

7. THE BEGINNINGS OF SCIENCE IN THE MIDDLE AGES

Mark Cartwright says that although there is much criticism that there was a Roman science in the Middle Ages, the ancient view that there was no truly identifiable scientific thought as a Roman science has been confirmed in modern times (Cartwright, 2016). Accordingly, that thought cannot be said to belong to the medieval period.

The Middle Ages was a period in which the Abrahamic religions were established or developed. At the beginning of that era, only Judaism existed, and Christianity and Islam were established later. But during the Middle Ages, Christianity was the most powerful. It began in the Apostolic Age and spanned the 17thcentury until Descartes' teachings, the last period of the Middle Ages. Through that, the Christian philosophy was established. Although Jewish philosophy was explored at the

[1]*Why did scientific studies decline in the Ancient Greek civilization?* (2024, January 14). Retrieved from Quora: https://www.quora.com/Why-did-scientific-studies-decline-in-the-Ancient-Greek-civilization#:~:text=Scientific%20studies%20in%20Ancient%20Greece,away%20from%20empirical%20scientific%20investigation.

[2]*The ancient Greek made many scientific discoveries, but they did not appear to have developed science in modern day sense. Why?* (2024, January 15). Retrieved from Quora: https://www.quora.com/The-ancient-Greek-made-many-scientific-discoveries-but-they-did-not-appear-to-have-developed-science-in-modern-day-sense-Why

[3]*Traces of Ancient Rome in the Modern World*. (2024, January 15). Retrieved from National Geographic: https://education.nationalgeographic.org/resource/traces-ancient-rome-modern-world/

beginning of the period, it was re-established in the 10th century. Islamic classical philosophy began in the ninth century and gradually declined by about the 15th century.

According to James A. Altena, early medieval Christian theology adopted a somewhat similar attitude toward science, which can be identified in two ways (Altena, 2024). On the one hand, the scriptures viewed the universe as an orderly and purposeful realm. It showed that nature could be studied, and the Genesis creation account of God's stewardship of the earth encouraged inquiry into nature. On the other hand, the Holy Scriptures were used to direct the fallen and distorted creation to the right path, and the curiosity of nature was used as a basis for the believer to pursue spiritual devotion to God and salvation, as well as to no longer become a trap of sin (Thate, 2017).

Many modern scientific disciplines and practices can be seen as beginnings, roots, sources, and hereditary heritages in the Church Fathers period (Sarfati, 2009). This scientific thinking based solely on God's creation is inherited from the classical tradition of ancient Greece. Philosophical knowledge dealing with the physical world (both physical and mathematical) was transmitted to the Roman Empire in various ways, especially during the patriarchal period. But the question of when the natural sciences made their first appearance as an activity or as a body of knowledge is to be inquired into, and to what avail. If so, it implies whether there was anything to be counted as science before the scientific renaissance of the 13th to 16th centuries (Lavallee, 1986). Accordingly, medieval science is the developmental and sole basis of the Renaissance.

In addition to the Christian Scriptures, the intellectual landscape of the early centuries of Christendom was defined by the classical tradition(Brooke & Numbers, 2011). It means learning about Greek and Roman scientific thought, moving vertically down through time and horizontally across geographical and cultural space. Church Fathers embraced the classical tradition of history, drama, poetry, political theory, metaphysics, epistemology, the scientific disciplines known as mathematics, and the natural sciences. These sciences included what we know as cosmology, astronomy, physics, optics, metallurgy, medicine, botany, zoology, and many others. But it is a version of the classical tradition inherited from the Christian church fathers. Many important Greek originals had already been lost, and very few Latin translations remained for Western scholars who had not read Greek. However, the works that were sufficiently preserved were Roman originals written in Latin(Lindberg, 2007).

The myth between Christian theology and science according to modern scientific thoughtScience points to the greatest myth in the history of Christian theology that they are in a constant state of conflict.

8. THE BEGINNINGS OF MEDIEVAL SCIENTIFIC THOUGHT

The idea of science in the Western Middle Ages was wide-ranging, encompassing many disciplines. To understand this, one must understand the Latin term "*Scientia*", which was coined in the 18th

century from the ancient word "*Scire*", meaning 'knowledge'.[4] Taylor McCall points out that it simply resembles the current form of science. In the Middle Ages, she adds, a theologian or thinker defined 'science' as that person's understanding of a particular topic(McCall, 2020). Accordingly, the terminology of modern science was created in the Middle Ages.

Medieval science consisted of the study of nature, mathematics, and natural philosophy in medieval Europe. With the fall of the Western Roman Empire and the decline of knowledge of the Greek language, Greek scientific thought died out(Laughlin, 1995). As a result, an important source of ancient learning was cut off in the Western Middle Ages. However, the Irish clergy maintained limited Greek writing along with Latin teaching for a period(Laughlin, 1995). Accordingly, the beginnings of medieval scientific thought were not created entirely under the Greek framework(Hernandez, 2022).

If so, the question may arise as to how medieval scientific thought was formed. The answer to this problem is that many Christian priests and scholars, from scientific theologians such as Boethius (470/475-524), St. Isidore of Seville (560-636), and the Venerable Bede (672/673-735) to Jean Buridan (1301-1358) and Nicole Oresme (1320/1323-1382), have maintained the scientific basis of rational inquiry(Durand, 1941). Nevertheless, the beginning of Western medieval scientific thought is recognized as a period of growth as well as decline. The continuity of philosophy in the ancient world was fallen when the emperor Justinian the Great closed down the Athenian Neo-Platonic school in 529(Watts, 2004). But this decision is one of the most famous and debated events of the later Roman Empire. But Neo-Platonic philosophy ended based on the philosophical investigations of John Scotus Erigena (815–877). However, he is also the founder of the new philosophy of Scholasticism(Moran & Guiu, 2019). The influence of scientific thought was also extremely important in the reconstruction of the collapsed Roman Empire. Here, that thought was recognized as important, and science was a theologically recognized righteous path to be pursued(Witte, 2019). Since the world was created by God, exploring how it works is an accepted doctrine among some theologians as honoring its Creator. Because science studies the general pattern of nature, they reasoned, there was no need to worry about the rare occasions when God intervened directly through miracles(Hannman, 2012). Jean Buridan explained it in the fourteenth century: "It is clear to us that every fire is hot, even if the power of God could do the opposite. Evidence of this kind is sufficient for the principles and conclusions of science(Collins, 2010)."

9. BASICALLY, FOUNDING EVENTS OF MEDIEVAL SCIENTIFIC THOUGHT

- Dionysius Exiguus (470-544) established the chronology of the world (BC and AD) based on the birth of Jesus as an essential foundation of science (Seidelmann&McCarthy, 2009).
- Boethius found the new boundaries in mathematics to be the beginning of Western medieval thought(Swetz, 2022).

[4] *"science"*. (2024, January 15). Retrieved from Merriam-Webster Online Dictionary: https://www.merriam-webster.com/dictionary/science

- Saint Isidore of Seville wrote the first encyclopedia, the *Etymologia*, explaining the sources of scientific research(Rusche, 2005).
- Using the scientific method, St. Bede accurately calculated the errors in the chronologies of the world presented by Dionysius Exiguus(Farmer, 1905). Also, the first scientific explanation of tides was made(Garvey, 2014). This is how scientific thought began in the Western Middle Ages.
- Many modern science manuals were written by Saint Albert the Great (1196–1200–1280). His writings included descriptions of alchemy, anthropology, architecture, astronomy, botany, climatology, chemistry, mechanics, meteorology, mineralogy, navigation, physics, psychology, weaving, and zoology (Powell, 2018).

10. LAYING THE GROUNDWORK FOR MODERN SCIENTIFIC THOUGHT

Western medieval scientific thought is not only Christian theology. Aristotelian philosophy, particularly after the Greek period, was rediscovered by Islamic philosophers in the ninth century. They explored many concepts of science on an Aristotelian basis and established scientific thinking. Al-Kindi (801–873) translated Aristotelian philosophy into Arabic, and through it, Al-Khawarizmi (780–850) invented algebra. Al-Batani (858–929) introduced new trigonometric formulas and even calculated the distance from the Earth to the Sun. Al-Razi (865–925) became a renowned pioneer in medicine. Al-Farabi (870–950) laid the foundations of Islamic education. Ibn Sina (980–1037) established its essentiality by composing the Manual of Medicine(Al-Andalusi, 2023). On this basis, the Jewish philosopher Maimonides (1138–1204) discovered new ideas in many sciences and presented important theories related to them(Freudenthal, 2012). However, a rapid assimilation of Islamic and Jewish science can also be detected in the early years of the second millennium. But those higher writings were preserved to the present day through Christian theology(Livesey & Brentjes, 2023).

Through Islamic thought, Aristotelian natural philosophy entered Europe through translations of Christian Latin philosophers (Burnett, 2008). In 1085, Gerard of Cremona (1114–1187) carried on the conversion work begun by Raymond of Toledo (1125–1152)(Burnett, 2001). However, due to errors in these translated works, St. Albert the Great undertook the work on a scientific basis(Moulin, 2006). William of Moerbeke (1215–1296) undertook the task at the request of St. Thomas Aquinas (1224–1225–1274), and he was also the last revivalist translator(Allan, 1952). Accordingly, the literary foundation of modern science was laid in the Middle Ages.

11. CENTERS OF SCIENTIFIC THOUGHT—THE FOUNDING OF UNIVERSITIES

The beginning of the present educational pattern took place after the collapse of the Western Roman Empire (Britannica, 2009). Philosophical thought was heavily influenced by the collapse of Rome, which had become the capital of classical thought after barbarian invasions(Peters, 2023). At that time, modern sciences were included in philosophy. Many educational institutions were destroyed, and thus the need for a new pattern of education arose(After the fall of the Roman Empire in 476 AD, human learning regressed. What were some of the factors contributing to the demise of formal

education throughout the Western world? 2024).[5] The predecessors of today's institutions of higher learning were monasteries and cathedrals within the framework of the Church. They were under the direct control of the church, and their teachers were priests and nuns. This monastery was also the main center of intellectual, cultural, and artistic development during this time. However, as urban educational centers became more important, places of higher learning were needed. As a result, a Papal Bull[6] of 1079 issued by Pope Gregory VII (1020–1085) began the transformation of cathedral schools into universities(Grendler, 1999). Accordingly, Bologna (1088), Paris (1150), Oxford (1167), Modena (1175), Palencia (1208), Cambridge (1209), Salamanca (1218), Montpellier (1220), Padua (1222), and Toulouse (1229) as the founding universities were established(Radelt, 2022). Early universities emphasized theological education, and the curriculum included other subjects such as philosophy, mathematics, humanities, medicine, law, and the liberal arts.

12. THE FORM OF THE FIELDS OF MEDIEVAL SCIENCE

It is important to understand the nature of each science to explain the fact that medieval scientific thought is the basis of today's field of science.

Chemistry: In the Middle Ages, chemistry was called alchemy. Alchemy was a mixture of philosophy and mysticism. It was theorized to be based on the right combination of earth, air, fire, and water. Alchemists believed that one substance could be transformed into another. Medieval alchemists produced hydrochloric acid, nitric acid, potash, and sodium carbonate. They were able to identify the elements arsenic, antimony, and bismuth. Through their experiments, medieval alchemists invented and developed laboratory devices and procedures that are still used today in modernized form. The practice of alchemy laid the foundation for the development of chemistry as a scientific discipline (Snell, 2019). Anxious to find the "philosopher's stone," an obscure substance believed to be able to create an elixir of immortality and transmute ordinary materials into gold, the great alchemist of this age was St. Albert the Great(Franklyn & Budd, 1935).

Medicine: Medieval medicine was empirical and practical. It mainly focused on curing diseases rather than finding their cause (Voigts, 1979). Islamic philosophers led by Al-Razi and Avicenna carried out extensive medical research and also wrote about them. But the advancement of medicine was set with the translation of Avicenna's book *al-Qānūn fī al-Ṭibb* (Latin name: *Canon Medicinae*, The Canon of Medicine) by Gerard of Cremona(Moosavi, 2009). Surgery was formally taught in Italy but was initially considered an inferior form of medicine. Guy de Chauliac (1300–1368) was the most important figure in the formal study of surgery(Grant, 1974). During the Crusades, the work of surgeons became important outside the hospital as well(Bellerby, 2024). In

[5]*After the fall of the Roman Empire in 476 AD, human learning regressed. What were some of the factors contributing to the demise of formal education throughout the Western world?* (2024, January 15). Retrieved from Quora: https://www.quora.com/After-the-fall-of-the-Roman-Empire-in-476-AD-human-learning-regressed-What-were-some-of-the-factors-contributing-to-the-demise-of-formal-education-throughout-the-Western-world#:~:text=The%20fall%20of%20the%20Roman%20Empire%20had%20a%

[6]Britannica, T. E. (2022, November 6). *Papal bull*. Retrieved from Encyclopedia Britannica: https://www.britannica.com/topic/bull-papalA **Papal Bull** is a formal document issued by the Pope. Bulls were legally binding and consequential when the Church dominated all aspects of life in Europe.

the mid-fourteenth century, London placed restrictions on what types of injuries surgeons could treat and what drugs they could prescribe or use because surgery was still considered an incredibly dangerous procedure (Kirkham & Warr, 2014).

Physics: Responsibility for the development of physics shifted from Greek physicists to Middle Eastern physicists and Western European philosophers. Greek physical thought stagnated, and intellectual thought began to shift to the Middle East. Western Europe cultivated rational scientific thought from religious thought and scholasticism. But later, they gradually inclined toward physicalistic thinking. Although discussed extensively in the East, ancient philosophy, which did not contradict Christian theology, was again relevant and widely discussed.[7] Where ancient philosophy was incompatible with Christian theology, scholastic schools were created. The theory of impulse was based on Aristotelian dynamics and was introduced by John Philoponus (490–570) in the sixth century. It was the forerunner of modern knowledge of inertia. Jean Buridan revived the theory in the fourteenth century. Ibn al-Haytham (Al-Hasan, 965–1040) was the greatest of Arab scientists. He is best known for his contributions to optics, physics, and the further development of scientific methods. His most famous and greatest work is Optics in seven volumes. It had a great influence on scientists, including Johannes Kepler, for a long time to come.

Even during the Renaissance, studies in astronomy were based on astrology. It was through the studies of Saint Albert the Great that astronomy was separated from astrology. It was at the request of Pope Urban IV (1195–1264). St. Albert's work on *Speculum Astronomiae* laid the foundations here (Zambelli, 2012). Through that, astrology became an occult science, and the growing fields of physics and astronomy shared many common points, many theories related to physics were used by later scientists to explain cosmological phenomena.[8]

St. Thomas Aquinas argues that all material things must derive their existence from something immaterial. Tim Anderson points out that a fundamental study of quantum physics field theory has been presented on this basis(Andersen, 2021). The field is an unnamed substance, and the field has its form by making it a localized point of a particle. Anderson says that the duality of his wave-particles can be seen in cases such as passing through a double-slit apparatus, a superposition of a particle. He further points out that only when it is observed as a matter of cause and effect does it appear to be a different situation.

In modern science, there is an overlap between physics and astronomy, and the beginnings of physicists using the universe as a vast laboratory to test theories through observations date back to the Renaissance (Blakstad, 2011). Scientists like Galileo (1564–1642), Newton, and Leibniz tried to create physical laws during the Renaissance.

[7] *Medieval Physics: Transition and Stagnation*. (2012, October 20). Retrieved from Physics 139 - The Birth of Physics – The Ancient Greeks to the Renaissance: https://blogs.umass.edu/p139ell/2012/10/30/169/
[8] Ibid.

Nicholas Copernicus initiated a new vision of Renaissance physics. He tried to create a model of the universe by mixing mathematics, cosmology, and physics(Tillman, 2022). Copernicus proposed a number of revolutionary ideas regarding the structure of the solar system and the position of the Earth in the sky. But it took a long time for Copernicus' ideas to be accepted(Blakstad, 2011). Galileo championed this model about 100 years later. But despite pressure from the Church against him, he believed that this heliocentric model of the universe conflicted with biblical principles. During the Renaissance, physics and astronomy were at the root of metaphysics(Leveillee, 2011).

No discussion of Renaissance physics would be complete without mentioning William Gilbert (1544–1603), who formally studied magnetism and electricity(Tietz, 2020). He studied the phenomenon of the magnet and compass, essential aids in a seafaring country like England.

Biology: The *Encyclopaedia Britannica* notes that the development of biology was sporadic in the 12th century (Britannica, 2024). Nevertheless, it was during this period that botany developed—the study of plants with medicinal properties. Similarly, zoology came from veterinary medicine and the pleasures of hunting. Because of the interest in medicinal plants, herbs in general began to be realistically described and depicted. It further states that while Arabic science was well-developed and far ahead of Latin, Byzantine, and Chinese cultures during that period, it showed signs of decline. On the other hand, the greatest naturalist of the Middle Ages, Albertus Magnus (St. Albert the Great), had biological writings (*De vegetabilibus*, seven books, and *De animalibus*, 26 books) of great importance (Mertz, 2024). His work contained a considerable number of new observations and facts. For example, he described with great precision the leaf anatomy and venation of the plants he studied.

Technological tools: Technological tools invented in the Middle Ages are still in high use today. These technologies were often just a matter of cultural exchange. Through agriculture, the effective use of land preparation, the gradual use of heavy plows and the use of horses for cultivation, the invention of horseshoes, two-season cultivation, and the bringing of water by pipes became more efficient and successful(Brooks, 2022). Through the rapid development of architecture and construction, the production of great mansions, buildings, bridges, and ovens to protect against cold, and the production of various types of cranes and wheelbarrows are remarkable creations of mechanics(McFadden, 2018). The production of oil paints and the creation of murals through them, paper mills, the production of paper, and the creation of watermarks through them spread(Murat, 2021). The development of blast furnaces to make cast iron and the use of rolling mills invented machines to meet daily needs(Lucas, 2005). The dry compass, the astronomical compass, and the cogwheel, necessary for naval technology, made navigation easier(Chakra, 2023).

Mysterious inventions: In the history of scientific achievements, the Middle Ages also bear a mystical dimension. St. Albert the Great has a special place here. He created an automaton (like a modern robot) capable of moving and speaking, which was the result of 20 years of research(Yanes, 2021). A 13th-century cuneiform clay tablet unearthed in an excavation in Austria has the same status as modern smartphones(Austin, 2016). Based on the incident of Moses spending 40 days in the desert, the 40-day quarantine centers for the epidemic that spread in Europe in the 14th century

have been anxious to control the spread of the disease(Frater, 2007). For the protection of their communities, they have created great forts, not only to protect themselves from wars(Cartwright, 2018).

13. SUMMARY

In this way, there are enough reasons to point out that the statements made that the medieval period was completely devoid of scientific thought are not correct.[9] It has continuously contributed to the development of science by introducing the formal scientific method. New products have also been introduced using technology. All teaching and literature were maintained in regional languages and internationally in Latin(Sidwell, 1995); dictionaries(Strayer, 1989) and encyclopedias(contributors, 2022) were introduced. Political theories such as the necessity of democracy, the responsibility and virtue of rulers, the appointment of rulers, and the removal of tyrants were developed(Møller, (2015). The judicial system especially Roman-Dutch Law has been established, and penal systems have been introduced (Vitiello, 2016). The foundation of building construction and the importance of the use of colors[10], the construction of hospitals and the training of doctors, the care and treatment of the sick(Bovey, 2015), the use of music and musical instruments (Gorlinski, 2011), etc., began in that era. In this way, the scientific thought that was ending in the Greek period was revived under a new form in the Middle Ages, and the development of various sciences fruitfully took place, preparing the initial stages of the present foundationGorlinski, 2011).

14. IMPORTANT DISCOVERIES AND OBSERVATIONS OF MEDIEVAL SCIENCE

Even though Christianity relied heavily on theology, science in the Middle Ages was an international affair(Falk, 2020). Latin was the official international language of universities throughout England, Germany, France, and Italy. Spain was particularly notable for translating Islamic texts (copies and translations of original and lost Greek scriptures) back into Latin for international distribution. This has led to the recovery of scientific sources previously unknown and lost to thought, prompting scholars to rediscover what was once lost to time. Both monastic orders and merchants used this opportunity to distribute newly written and newly copied tomes throughout Europe in hopes of spreading knowledge and enlightenment(Macchioro, 2022).

Much more happened in the Middle Ages than the retreading of old ground laid out by ancient Greek scholars. Despite the Church's wish that all things should be left to God, many scientific discoveries were made during the Renaissance period, which is now considered a lack of scientific exploration or research.

- Johannes Gutenberg's printing press in Germany was probably the most important invention of the Middle Ages(McFadden, 2023).
- The invention of the mechanical clock dates to the 14th century when it once again found its place as a time-keeping tool used by monastic orders(Tourneau, 2013).

[9]*Science & Technology of the Medieval Era*. (2009). Retrieved from Great Northern Medieval Fayre: http://medievalfayre.com/index.php?option=com_content&view=article&id=84&Itemid=85
[10]*Science & Technology of the Medieval Era*. (2009). Retrieved from Great Northern Medieval Fayre: http://medievalfayre.com/index.php?option=com_content&view=article&id=84&Itemid=85

- Oxford calculators, named for the University of Oxford, the place of their invention, enabled scientists to measure elements such as speed and temperature with greater precision(Sylla, 1973).
- First, spectacles were invented in the Middle Ages as a byproduct of research into optics and lenses(Cybulskie, 2022).
- After that, research on sunlight, rays, and light is often attributed to European scholars but owes its roots equally to Muslim scholars(Smith, 2004).
- While the Middle Ages placed God at the center of creation, scholars did not shy away from asking big questions about how nature worked. However, as stated, the two are so fundamentally intertwined that it is almost impossible to view science and theology as separate entities(Gay, 1963).
- The focus of Renaissance curiosity was astronomy. One need only look at a starry sky to wonder what the universe is really made of. This is the line of thought that many scholars of the Middle Ages tried to follow through their research(Keene, 2019). We can trace the origins of cosmology back to Plato and Aristotle. But their philosophies depend on the earthly and completely abandon the heavenly.
- Medieval scholars were able to draw a parallel between the heavenly and the earthly, justifying that what happens here is reflected in your journey up there. This has also been subjugated to Christianity and the concept of living a healthy earthly life to ensure your place in heaven. For medieval scientists, the Earth was the center of the universe, and everything else revolved around it. That does not mean that scholars have ignored the solar system and planets as we know them today(Hernandez, 2022).
- The astrolabe was an instrument that traveled from the Middle East to Europe in the 11th century and was used for astronomical predictions(Chesnutt, 2016). Planetary body positions were used closely with the zodiac to determine the best time to perform various earthly activities or medical procedures.
- In the 12th century, mathematics, arithmetic, and geometry gradually entered the field of astronomy, helping to advance all these fields(O'Connor & Robertson, 2008).
- Medicine is a field that can be seen in a completely different light compared to the current way of thinking (Lysanets & Bieliaieva, 2018). Following the familiar pattern of theology, many diseases were seen as punishments for the actions of God and the misdeeds of mankind. Such was the case with the infamous Black Death that devastated the European continent, interpreted as the final punishment of mankind.
- However, people did not ignore environmental disasters and climate change. Although it remains a godly form, it can be studied and anticipated more easily than disease(Casile, 2021). As astronomy continued its development into the Middle Ages, scholars were able to identify patterns more clearly in nature and contribute to the field of medicine. It is also true that the idea of the interdependence of the spiritual (mind) and the earthly (body) dates back to the Middle Ages.
- Various herbs and medicines were used, studied, and then cataloged by monastic orders and spread across the continent as guides for healing the afflicted (Hajar, 2012). Combined with the

concept of soul-body unity, Christian priests and pilgrims could practice religion and belief with the population due to the continental educational disparity.

- Astrology, which had a mystical form, was also transformed into a scientific form during the medieval Renaissance. Astronomy had become a part of astrology itself, but there was also the creation of independent astronomy, separating the two fields. It was also during this period that the exclusion of black astrology began(Zambelli, 2012).
- To prevent the enemy's invasions, wars, and internal conflict, various weapons were produced with the intention of protecting their controlled areas. Despite the fall of Rome, the Byzantines developed devastating weapons of war through scientific research to defend themselves against Islamic invasions. Its growth can be seen nowadays (Runciman, 1965).

15. Conclusion

It's easy to look at the Middle Ages from a 21st-century perspective and mock the many mistakes and poor decisions in scientific studies of that era. But without the foundations established during that era, modern understanding of subjects such as mathematics, chemistry, medicine, physics, and astronomy would be seriously lacking. With the supremacy of the Church becoming all-powerful in the Middle Ages, the only way any real scientific progress could be made was under its supremacy. It implies that it is correct that scientific thought existed in the Middle Ages. There are two primary functions that the scientific tradition performed scientifically in the Middle Ages. First, Greek-language science died out with the closing of the Neo-Platonic school, but classical scientific thought was preserved through the Latin tradition. Secondly, a religious culture supported universities for the first time in history to maintain the fulfillment of the fundamental disciplinary responsibility of science. Although philosophically sustained, medieval scientists were able to formally establish its experimental basis. Although critics say that medieval Christianity was directly opposed to scientific research, some clergy even maintained advanced laboratories (Siviour, Smithson, & Harrison, 2024).[11] Many universities were supported by the Church to investigate epistemologically, methodologically, and mathematically the nature of the universe in which they lived. Although the Middle Ages were said to be the main obstacle to scientific thought, the greatest patron of universities in that era was the Christian Church. Although some commentators try to misinterpret the whole based on certain events, it is only an attempt to confirm personal preferences. Finally, it is important to explain Sir Isaac Newton. That is 'if I have gone a little further, it is to stand on the shoulders of giants(Falk, 2020).' There is a strong difference between myth and real truth.

REFERENCES

1. *After the fall of the Roman Empire in 476 AD, human learning regressed. What were some of the factors contributing to the demise of formal education throughout the Western world?* (2024, January 15). Retrieved from Quora: https://www.quora.com/After-the-fall-of-the-Roman-Empire-in-476-AD-human-learning-regressed-What-were-some-of-the-factors-

contributing-to-the-demise-of-formal-education-throughout-the-Western-world#:~:text=The%20fall%20of%20the%20Roman%20Empire%20had%20a%

2. Al-Andalusi, A. A. (2023, May 30). *The Structure of Scientific Productivity in Islamic Civilization: Orientalists' Fables*. Retrieved from Yaqeen Institute for Islamic Research: https://yaqeeninstitute.org/read/paper/the-structure-of-scientific-productivity-in-islamic-civilization-orientalists-fables
3. Allan, D. (1952). Aristotle's De Anima: in the Version of William of Moerbeke and the Commentary of St. Thomas Aquinas. *The Journal of Ecclesiastical History, Volume 3 Issue 2*, 231-233.
4. Altena, J. A. (2024, January 8). *"Science and Christianity During the Sixteenth and Seventeenth Centuries ." Science and Its Times: Understanding the Social Significance of Scientific Discovery*. Retrieved from Encyclopedia.com: https://www.encyclopedia.com/science/encyclopedias-almanacs-transcripts-and-maps/science-and-christianity-during-sixteenth-and-seventeenth-centuries
5. Andersen, T. (2021, November 6). *Thomas Aquinas, Quantum Physics, and the Nature of Reality*. Retrieved from The Universe of Tim Andersen: https://andersenuniverse.com/2021/11/06/thomas-aquinas-quantum-physics-and-the-nature-of-reality/#:~:text=Ultimately%2C%20Aquinas%20would%20argue%20that,its%20having%20been%20given%20form.
6. Austin, J. (2016, September 11). *Could archaeologists' discovery of an '800-year-old mobile phone' prove time travel is real?* Retrieved from Express Newspapers: https://www.express.co.uk/news/science/630034/archaeologists-discovery-800-year-old-mobile-phone-prove-time-travel-real
7. Barnish, S. (1992). *Cassiodorus: Variae'*. Oakland, California: University of California Press.
8. Bellerby, R. (2024, January 15). *Surgery in Medieval Times*. Retrieved from WayBackMachine: https://suite.io/rachel-bellerby/17da204
9. Betts, J. R. (1959). Darwinism, Evolution, and American Catholic Thought, 1860-1900. *The Catholic Historical Review Vol. 45, No. 2*, 161-185.
10. Blakstad, O. (2011, September 16). *Renaissance Physics: Standing On the Shoulder of Giants*. Retrieved from Explorable.com: https://explorable.com/renaissance-physics
11. Boorstin, D. J. (1983). *The Discoverers: A History of Man's Search to Know His World and Himself*. New York: Random House.
12. Britannica, T. E. (2009, April 28). *Europe in the Middle Ages: The background of early Christian education*. Retrieved from Encyclopædia Britannica: https://www.britannica.com/topic/education/Europe-in-the-Middle-Ages
13. Britannica, T. E. (2022, November 6). *Papal bull*. Retrieved from Encyclopedia Britannica: https://www.britannica.com/topic/bull-papal
14. Britannica, T. E. (2024, January 15). *Development of botany and zoology*. Retrieved from Encyclopaedia Britannica: https://www.britannica.com/science/biology/The-Arab-world-and-the-European-Middle-Ages
15. Britannica, T. E. (2024, January 15). *Forms of Christian education*. Retrieved from Encyclopedia Britannica: https://www.britannica.com/topic/Christianity/Church-and-education

16. Britannica, T. E. (2024, January 15). *Science in Rome and Christianity*. Retrieved from Encyclopedia Britannica: https://www.britannica.com/science/history-of-science/Science-in-Rome-and-Christianity
17. Brooke, J. H., & Numbers, R. L. (2011). *Science and Religion Around the World.* Oxford: Oxford University Press.
18. Brooks, C. (2022, August 26). *1.6: The Medieval Agricultural Revolution*. Retrieved from LibreTexts libraries: https://human.libretexts.org/Bookshelves/History/World_History/Western_Civilization_-_A_Concise_History_II_(Brooks)/01%3A_The_Crusades_and_the_High_Middle_Ages/1.06%3A_The_Medieval_Agricultural_Revolution
19. Brown, C. S. (2013). *Claudius Ptolemy*. Retrieved from Khan Academy: https://www.khanacademy.org/humanities/big-history-project/big-bang/how-did-big-bang-change/a/claudius-ptolemy
20. Burnett, C. (2001). The Coherence of the Arabic-Latin Translation Program in Toledo in the Twelfth Century. *Science in Context, Volume 14, Issue 1-2*, 249-288. Retrieved from Science in Context.
21. Burnett, C. (2008, July 01). *Tracing the Impact of Latin Translations of Arabic Texts on European Society*. Retrieved from MuslimHeritage.com: https://muslimheritage.com/impact-latin-translations-arabic-texts-euro-society/
22. Cartwright, M. (2016, September 6). *Roman Science*. Retrieved from World History Encyclopedia: https://www.worldhistory.org/Roman_Science/
23. Cartwright, M. (2018, May 17). *Medieval Castle*. Retrieved from World History Encyclopedia: https://www.worldhistory.org/Medieval_Castle/
24. Casile, A. (2021, January 25). Climatic Variation and Society in Medieval South Asia: Unexplored Threads of History and Archaeology of Mandu. *The Medieval History Journal 24(1–2)*, 56–91.
25. Chakra, H. (2023, February 17). *Life Without GPS | The Amazing Tools People Used To Navigate In The Middle Ages*. Retrieved from About History: https://about-history.com/life-without-gps-the-amazing-tools-people-used-to-navigate-in-the-middle-ages/
26. Chaniotis, A. (2010). *Greek History: Hellenistic: Oxford Bibliographies Online Research Guide.* New York: Oxford University Press.
27. Chesnutt, B. (2016, June 19). *Arabic Astrolabe: Definition, Navigation & History*. Retrieved from Study.com: https://study.com/academy/lesson/arabic-astrolabe-definition-navigation-history.html
28. Chroust, A.-H. (1966). Aristotle's Flight from Athens in the Year 323 B.C. *Historia: Zeitschrift für Alte Geschichte Bd. 15, H. 2*, 185-192.
29. Clarke, L. W. (1962). Greek Astronomy and Its Debt to the Babylonians. *The British Journal for the History of Science Vol. 1, No. 1*, 65-77.
30. Colgrave, B. (1999). *The Ecclesiastical History of the English People; The Greater Chronicle; Bede's Letter to Egbert.* Oxford: Oxford University Press.
31. Collins, F. (2010, January 24). *Medieval Science*. Retrieved from Quodlibeta: https://bedejournal.blogspot.com/2010/01/francis-collins-and-medieval-science.html

32. Cormack, L. B. (2010). That Medieval Christians Taught That the Earth Was Flat. In R. L. Numbers, *Galileo Goes to Jail and Other Myths about Science and Religion* (pp. 28-34). Cambridge, Massachusetts: Harvard University Press.
33. Cybulskie, D. (2022, November 21). *Medieval Eyeglasses: Wearable Technology of the Thirteenth Century*. Retrieved from Medievalists.net: https://www.medievalists.net/2016/03/medieval-eyeglasses-wearable-technology-of-the-thirteenth-century/
34. Davis, E. B. (2010). That Isaac Newton's Mechanistic Cosmology Eliminated the Need for God. In R. L. Numbers, *Galileo Goes to Jail and Other Myths about Science and Religion* (pp. 115-122). Cambridge, Massachusetts: Harvard University Press.
35. Dorandi, T. (2013). *Diogenes Laertius. Lives of Eminent Philosophers.* Cambridge: Cambridge University Press.
36. Durand, D. B. (1941). Nicole Oresme and the Mediaeval Origins of Modern Science. *Speculum Vol. 16, No. 2*, 167-185.
37. Efron, N. J. (2010). That Christianity Gave Birth to Modern Science. In R. L. Numbers, *Galileo Goes to Jail and Other Myths about Science and Religion* (pp. 79-89). Cambridge, Massachusetts: Harvard University Press.
38. Falk, S. (2020, October 26). *The genius of medieval science: from medicine to mechanical clocks*. Retrieved April 20, 2022, from BBC History Magazine: https://www.historyextra.com/period/medieval/medieval-science-medicine-dark-ages-discoveries/
39. Farmer, D. H. (1905). *About Bede's Ecclesiastical History of England.* London: George Bell and Sons.
40. Ferguson, J. (2005). *Saint Clement of Alexandria: Stromateis. Books one to three.* Washington D.C.: Catholic University of America Press.
41. Finocchiaro, M. A. (2010). That Galileo Was Imprisoned and Tortured for Advocating Copernicanism. In R. L. Numbers, *Galileo Goes to Jail and Other Myths about Science and Religion* (pp. 68-78). Cambridge, Massachusetts: Harvard University Press.
42. Frank, P. (1952). The Origin of the Separation between Science and Philosophy. *Proceedings of the American Academy of Arts and Sciences, Vol. 80, No. 2*, 115-139.
43. Franklyn, J., & Budd, F. E. (1935). *A Survey of the Occult.* London: Philip Barker Publications.
44. Frater, J. (2007, September 22). *Top 10 Inventions of the Middle Ages - Quarantine*. Retrieved from Listverse: https://listverse.com/2007/09/22/top-10-inventions-of-the-middle-ages/
45. Freeman, C. (2002). *The Closing of the Western Mind: The Rise of Faith and the Fall of Reason.* London: Penguin Random House.
46. Freudenthal, G. (2012). *Science in Medieval Jewish Cultures.* Cambridge: Cambridge University Press.
47. Garvey, J. (2014, June 23). *How the venerable Bede got us to the Moon*. Retrieved from The Hump of the Camel: https://potiphar.jongarvey.co.uk/2014/06/23/how-the-venerable-bede-got-us-to-the-moon/
48. Gay, J. H. (1963). Four Medieval Views of Creation. *The Harvard Theological Review Vol. 56, No. 4*, 243-273.

49. Gill, N. (2019, July 16). *Inventions and Discoveries of Ancient Greek Scientists*. Retrieved April 19, 2022, from ThoughtCo: https://www.thoughtco.com/ancient-greek-scientists-inventions-and-discoveries-120966
50. Golding, B. (2018, May 23). *Monastery*. Retrieved April 20, 2022, from Encyclopedia.com: https://www.encyclopedia.com/history/modern-europe/british-and-irish-history/monasteries
51. Grant, E. (1962). Late Medieval Thought, Copernicus, and the Scientific Revolution. *Journal of the History of Ideas*, 197-220.
52. Grant, E. (1974). *A Source Book in Medieval Science.* Cambridge, Massachusetts: Harvard University Press.
53. Grendler, P. F. (1999). The University of Bologna, the city, and the papacy. *Renaissance Studies Vol. 13, No. 4*, 475-485.
54. Hajar, R. (2012). The Air of History (Part II) Medicine in the Middle Ages. *Heart Views13(4)*, 158–162.
55. Hamlyn, D. W. (1992). *Being a Philosopher: The History of a Practice.* London: Routledge.
56. Hannam, J. (2009). *God's Philosophers: How the Medieval World Laid the Foundations of Modern Science.* London: Icon Books Ltd.
57. Hannman, J. (2012, October 31). *Medieval Christianity and the Rise of Modern Science*. Retrieved from BioLogos: https://biologos.org/articles/medieval-christianity-and-the-rise-of-modern-science
58. Hendrix, S. E. (2010). *How Albert the Great's Speculum Astronomiae was interpreted and used by four centuries of readers. A Study in Late Medieval Medicine, Astronomy and Astrology.* Lewiston, New York: Edwin Mellen Press.
59. Hernandez, B. (2022, November 6). *Science in the Middle Ages – Rediscovering its Latent Genius*. Retrieved from Medievalists.net: https://www.medievalists.net/2021/02/science-in-the-middle-ages/
60. Holmes, [. F. (1851). Philosophy and Faith. *Methodist Quarterly Review 3*, 185–218.
61. Hughes, T. (2022, April 1). *What Happened After Alexander the Great Died?* Retrieved from History Hit: https://www.historyhit.com/what-happened-after-alexander-the-great-died/
62. Johnson, C., Affolter, M. D., Inkenbrandt, P., & Mosher, C. (2024, January 14). *Early Scientific Thought*. Retrieved from LibreTexts GEOSCIENCES: https://geo.libretexts.org/Courses/California_State_University_Los_Angeles/Book%3A_An_Introduction_to_Geology_(Johnson_Affolter_Inkenbrandt_and_Mosher)/01%3A_Understanding_Science/1.03%3A_Early_Scientific_Thought
63. Keene, B. C. (2019, April 30). *Written in the Stars: Astronomy and Astrology in Medieval Manuscripts*. Retrieved from Getty: https://www.getty.edu/news/written-in-the-stars-astronomy-and-astrology-in-medieval-manuscripts/
64. Kirkham, A., & Warr, C. (2014). *Wounds in the Middle Ages.* Aldershot, Hampshire: Ashgate.
65. Laughlin, B. (1995). *The Aristotle Adventure: A Guide to the Greek, Arabic, & Latin Scholars Who Transmitted Aristotle's Logic to the Renaissance.* Clear Spring, Maryland: AbeBooks.
66. Lavallee, L. (1986, October 1). *The Early Church Defended Creation Science*. Retrieved from Institute for Creation Research: https://www.icr.org/article/early-church-defended-creation-science

67. Leveillee, N. P. (2011). Copernicus, Galileo, and the Church: Science in a Religious World. *Inquiries Journal/Student Pulse, 3(05)*, 1-2.
68. Lindberg, D. C. (2007). *Science before the Greeks: The Beginnings of Western Science.* Chicago: University of Chicago Press.
69. Lindberg, D. C. (2010). That the Rise of Christianity Was Responsible for the Demise of Ancient Science. In R. L. Numbers, *Galileo Goes to Jail and Other Myths about Science and Religion* (pp. 8-18). Cambridge, Massachusetts: Harvard University Press.
70. Livesey, S. J., & Brentjes, S. (2023). Science in the Medieval Christian and Islamic Worlds. In I. R. Morus, *The Oxford History of Science* (pp. 76-112). Oxford: Oxford University Press.
71. Lolos, E. (2018). *What knowledge (or sciences) did Alexander the Great bring us?* Retrieved from Quora, Inc.: https://www.quora.com/What-knowledge-or-sciences-did-Alexander-the-Great-bring-us
72. Lucas, A. R. (2005). Industrial Milling in the Ancient and Medieval Worlds: A Survey of the Evidence for an Industrial Revolution in Medieval Europe. *Technology and Culture Vol. 46, No. 1*, 1-30.
73. Lysanets, Y. V., & Bieliaieva, O. M. (2018). The use of Latin terminology in medical case reports: quantitative, structural, and thematic analysis. *Journal of Medical Case Reports volume 12, Article number: 45*, 1-10.
74. Macchioro, R. (2022, November 21). *Book production and circulation from Antiquity to the Middle Ages*. Retrieved from Medievalists.net: https://www.medievalists.net/2021/09/book-production-circulation-antiquity-middle-ages/
75. Manchester, W. (1992). *A World Lit Only by Fire: The Medieval Mind and the Renaissance: Portrait of an Age.* New York: Little, Brown and Company.
76. Mark, J. J. (2023, July 28). *Ancient Greek Science*. Retrieved from World History Encyclopedia: https://www.worldhistory.org/Greek_Science/
77. McCall, T. (2020, November 6). *Medieval science and mathematics*. Retrieved from British Library: https://brewminate.com/medieval-science-and-mathematics/
78. McFadden, C. (2018, April 28). *Mechanical Engineering in the Middle Ages: The Catapult, Mechanical Clocks and Many More We Never Knew About*. Retrieved from Interesting Engineering: https://interestingengineering.com/innovation/mechanical-engineering-in-the-middle-ages-the-catapult-mechanical-clocks-and-many-more-we-never-knew-about
79. McFadden, C. (2023, March 3). *18 Inventions that shaped Europe in the Middle Ages*. Retrieved from Interesting Engineering: https://interestingengineering.com/lists/18-inventions-of-the-middle-ages-that-changed-the-world
80. Mertz, L. A. (2024, January 15). *The Contributions Of Albertus Magnus And The Development Of Zoology During The Thirteenth Through The Fifteenth Centuries*. Retrieved from Encyclopedia.com: https://www.encyclopedia.com/science/encyclopedias-almanacs-transcripts-and-maps/contributions-albertus-magnus-and-development-zoology-during-thirteenth-through-fifteenth-centuries
81. Moore, J. (2010). That Evolution Destroyed Darwin's Faith in Christianity—Until He Reconverted on His Deathbed. In R. L. Numbers, *Galileo Goes to Jail and Other Myths about Science and Religion* (pp. 142-151). Cambridge, Massachusetts: Harvard University Press.

82. Moosavi, J. (2009). The place of Avicenna in the history of medicine. *Avicenna J Med Biotechnol Vol. 1*, 3–8.
83. Moran, D., & Guiu, A. (2019, October 19). *John Scottus Eriugena*. Retrieved from The Stanford Encyclopedia of Philosophy: https://plato.stanford.edu/archives/win2021/entries/scottus-eriugena/
84. Moulin, I. (2006). Albert the Great Interpreting Aristotle: Intimacy and Independence. *The Journal of Medieval Latin Vol. 18, Proceedings of the Fifth International Congress for Medieval Latin Studies*, 158-170.
85. Murat, Z. (2021). Wall paintings through the ages: the medieval period (Italy, twelfth to fifteenth century). *Archaeological and Anthropological Sciences (2021) 13: 191*, 1-28.
86. Numbers, R. L. (2010). *Galileo Goes to Jail and Other Myths about Science and Religion.* Cambridge, Massachusetts: Harvard University Press.
87. O'Connor, J. J., & Robertson, E. F. (2008, September 20). *MacTutor History of Mathematics archive: Abu Ali al-Hasan ibn al-Haytham*. Retrieved from School of Mathematics and Statistics, University of St Andrews: https://mathshistory.st-andrews.ac.uk/Biographies/Al-Haytham/
88. Osler, M. J. (2010). That the Scientific Revolution Liberated Science from Religion. In R. L. Numbers, *Galileo Goes to Jail and Other Myths about Science and Religion* (pp. 90-98). Cambridge, Massachusetts: Harvard University Press.
89. Park, K. (2010). That the Medieval Church Prohibited Human Dissection. In R. L. Numbers, *Galileo Goes to Jail and Other Myths about Science and Religion* (pp. 43-49). Cambridge, Massachusetts: Harvard University Press.
90. Pasipoularides, A. (2014). Galen, father of systematic medicine. An essay on the evolution of modern medicine and cardiology. *Journal of National Library of Medicine 1;172(1)*, 47-58.
91. Peters, M. A. (2023). Civilizational collapse, eschatological narratives, and apocalyptic philosophy. *Educational Philosophy and Theory, 55:14*, 1599-1607.
92. Philip, S. (2004). *Ante-Nicene Fathers. In 10 vols. Volume 02. Fathers of the Second Century: Hermas, Tatian, Athenagoras, Theophilus, and Clement of Alexandria.* Michigan: Grand Rapids.
93. Pope-Benedict-XVI. (2008, March 12). *Boethius and Cassiodorus*. Retrieved from Libreria Editrice Vaticana: https://www.vatican.va/content/benedict-xvi/en/audiences/2008/documents/hf_ben-xvi_aud_20080312.html
94. Powell, D. (2018, November 15). *Albert the Great and His Scientific Discoveries*. Retrieved from Dominican Publications: https://dominicanpublications.com/blogs/dominican-publications-blog/albert-the-great-and-his-scientific-discoveries
95. Principe, L. M. (2010). That Catholics Did Not Contribute to the Scientific Revolution. In R. L. Numbers, *Galileo Goes to Jail and Other Myths about Science and Religion* (pp. 99-108). Cambridge, Massachusetts: Harvard University Press.
96. Radelt, L. (2022, November 6). *Medieval Universities*. Retrieved from StudySmarter: https://www.studysmarter.co.uk/explanations/history/modern-world-history/medieval-universities/
97. Runciman, S. (1965). *Fall of Constantinople.* Cambridge: Cambridge University Press.

98. Rusche, P. G. (2005). Isidore's "Etymologiae" and the Canterbury Aldhelm Scholia. *The Journal of English and Germanic Philology, Vol. 104, No. 4*, 437-455.
99. Russo, L. (2004). *The Forgotten Revolution: how science was born in 300 BC and why it had to be reborn.* New York: Springer.
100. Sarfati, J. (2009, September 29). *The biblical roots of modern science*. Retrieved from Creation Ministries International: https://creation.com/biblical-roots-of-modern-science
101. Schoepflin, R. B. (2010). That the Church Denounced Anesthesia in Childbirth on Biblical Grounds. In R. L. Numbers, *Galileo Goes to Jail and Other Myths about Science and Religion* (pp. 123-130). Cambridge, Massachusetts: Harvard University Press.
102. *Science & Technology of the Medieval Era*. (2009). Retrieved from Great Northern Medieval Fayre: http://medievalfayre.com/index.php?option=com_content&view=article&id=84&Itemid=85
103. Seidelmann, P. K., & Mccarthy, D. D. (2009). *TIME From Earth Rotation to Atomic Physics.* Hoboken, New Jersey: Wiley Publication.
104. Shackelford, J. (2010). That Giordano Bruno Was the First Martyr of Modern Science. In R. L. Numbers, *Galileo Goes to Jail and Other Myths about Science and Religion* (pp. 59-67). Cambridge, Massachusetts: Harvard University Press.
105. Shank, M. H. (2010). That the Medieval Christian Church Suppressed the Growth of Science. In R. L. Numbers, *Galileo Goes to Jail and Other Myths about Science and Religion* (pp. 19-27). Cambridge, Massachusetts: Harvard University Press.
106. Siviour, C., Smithson, H., & Harrison, C. (2024, April 29). *The Mental and Material Laboratories of 13th Century Science*. Retrieved from TORCH | The Oxford Research Centre in the Humanities: https://www.torch.ox.ac.uk/the-mental-and-material-laboratories-of-13th-century-science
107. Smith, A. M. (2004). What Is the History of Medieval Optics Really about? *Proceedings of the American Philosophical Society Vol. 148, No. 2*, 180-194.
108. Snapp, J. (2019, July 11). *Hort's Lecture on Hippolytus and Clement of Alexandria*. Retrieved from Awesome Inc: https://www.thetextofthegospels.com/2019/07/horts-lecture-on-hippolytus-and-clement.html
109. Snell, M. (2019, July 3). *Alchemy in the Middle Ages*. Retrieved from ThoughtCo: https://www.thoughtco.com/alchemy-in-the-middle-ages-1788253
110. Snobelen, S. (2017, February 17). *The Myth of the "Medieval Gap"*. Retrieved from BioLogos: https://biologos.org/articles/the-myth-of-the-medieval-gap
111. Stanton, E. C. (1897). Reading the Bible in the Public Schools. *The Arena 17*, 1033–37.
112. Swetz, F. J. (2022, November 8). *Mathematical Treasure: The Arithmetic of Boethius*. Retrieved from Mathematical Association of America: https://www.maa.org/press/periodicals/convergence/mathematical-treasure-the-arithmetic-of-boethius
113. Sylla, E. D. (1973). Medieval Concepts of the Latitude of Forms: The Oxford Calculators. *Archives d'histoire doctrinale et littéraire du Moyen Age Vol. 40*, 223-283.
114. *The ancient Greeks made many scientific discoveries, but they did not appear to have developed science in the modern-day sense. Why?* (2024, January 15). Retrieved from Quora:

https://www.quora.com/The-ancient-Greek-made-many-scientific-discoveries-but-they-did-not-appear-to-have-developed-science-in-modern-day-sense-Why

115. Thigpen, C. L. (2020, August 20). *On the Intersection of Science and Religion*. Retrieved from Pew Research Center: https://www.pewresearch.org/religion/2020/08/26/on-the-intersection-of-science-and-religion/
116. Tietz, T. (2020, May 24). *William Gilbert – The Father of Electrical Studies*. Retrieved from SciHi Blog: http://scihi.org/william-gilbert/
117. Tihon, A. (2012). Science in the Byzantine Empire. *The Cambridge History of Science,* 190-206.
118. Tikkanen, A. (2006, October 26). *Greek science*. Retrieved from Encyclopaedia Britannica: https://www.britannica.com/science/history-of-science/Greek-science
119. Tillman, N. T. (2022, January 17). *Nicolaus Copernicus Biography: Facts & discoveries*. Retrieved from Space.com: https://www.space.com/15684-nicolaus-copernicus.html
120. Tourneau. (2013, December 6). *The History of Mechanical Watches*. Retrieved from Mechanical Watch: https://mechanicalwatch.weebly.com/history.html
121. *Traces of Ancient Rome in the Modern World*. (2024, January 15). Retrieved from National Geographic: https://education.nationalgeographic.org/resource/traces-ancient-rome-modern-world/
122. Turner, H. R. (1997). *Science in Medieval Islam: An Illustrated Introduction.* Austin, Texas: University of Texas Press.
123. Tyndall, J. (1889). *Fragments of Science, 6th edition.* New York: D. Appleton Publication.
124. Violatti, C. (2013, June 13). *Ancient Greek Science*. Retrieved from World History Encyclopedia: https://www.worldhistory.org/Greek_Science/
125. Voigts, L. (1979). Anglo-Saxon Plant Remedies and the Anglo-Saxons. *Isis. 70 (2),* 250–268.
126. Wand, J. W. (1975). *A History of the Early Church to AD 500.* London: Routledge.
127. Waterfield, R. (2018). *Creators, Conquerors, and Citizens: A History of Ancient Greece.* New York: Oxford University Press.
128. Watts, E. (2004). Justinian, Malalas, and the End of Athenian Philosophical Teaching in A.D. 529. *The Journal of Roman Studies, Volume 94,* 168-182.
129. Wentzel Van Huyssteen, N. H. (2003). *Encyclopedia of Science and Religion.* New York: Macmillan Reference.
130. Westfall R.S. (1981). *Never at Rest: A Biography of Isaac Newton.* Cambridge: Cambridge University Press.
131. *Why did scientific studies decline in the Ancient Greek civilization?* (2024, January 14). Retrieved from Quora: https://www.quora.com/Why-did-scientific-studies-decline-in-the-Ancient-Greek-civilization#:~:text=Scientific%20studies%20in%20Ancient%20Greece,away%20from%20empirical%20scientific%20investigation.
132. Witte, M. D. (2019, October 23). *The absence of the Roman Empire fueled Western civilization*. Retrieved from Stanford News: https://news.stanford.edu/2019/10/23/fall-rome-europes-lucky-break/

133. Yanes, J. (2021, December 15). *Albertus Magnus, the Saint of Science*. Retrieved from Open Mind BBVA Group: https://www.bbvaopenmind.com/en/science/leading-figures/albertus-magnus-the-saint-of-science/
134. Yegge, J. G. (2009). *A Historical Analysis of the Relationship of Faith.* London: Icon Books.
135. Zambelli, P. (2012). *Astrology and Magic from the Medieval Latin and Islamic World to Renaissance Europe: Theories and Approaches.* London: Routledge.