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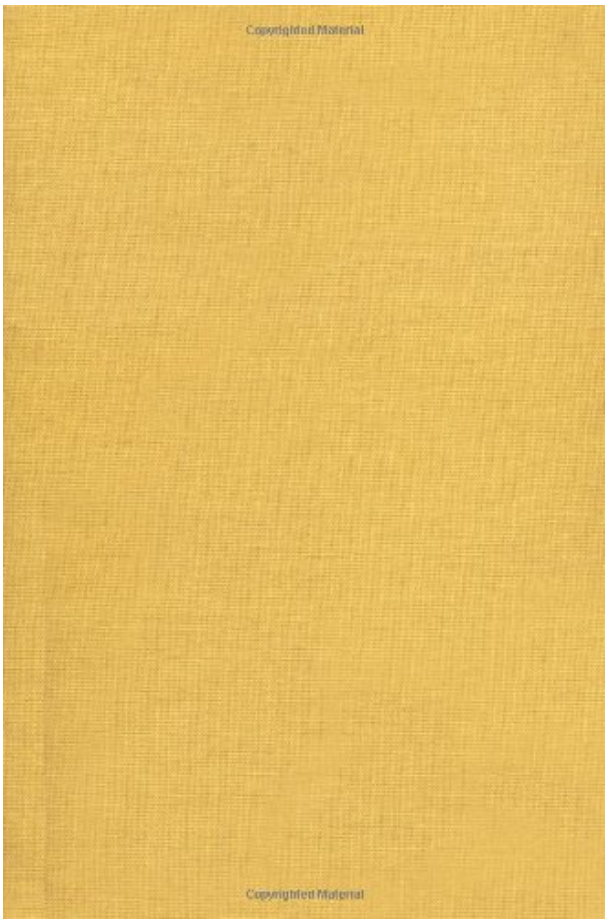

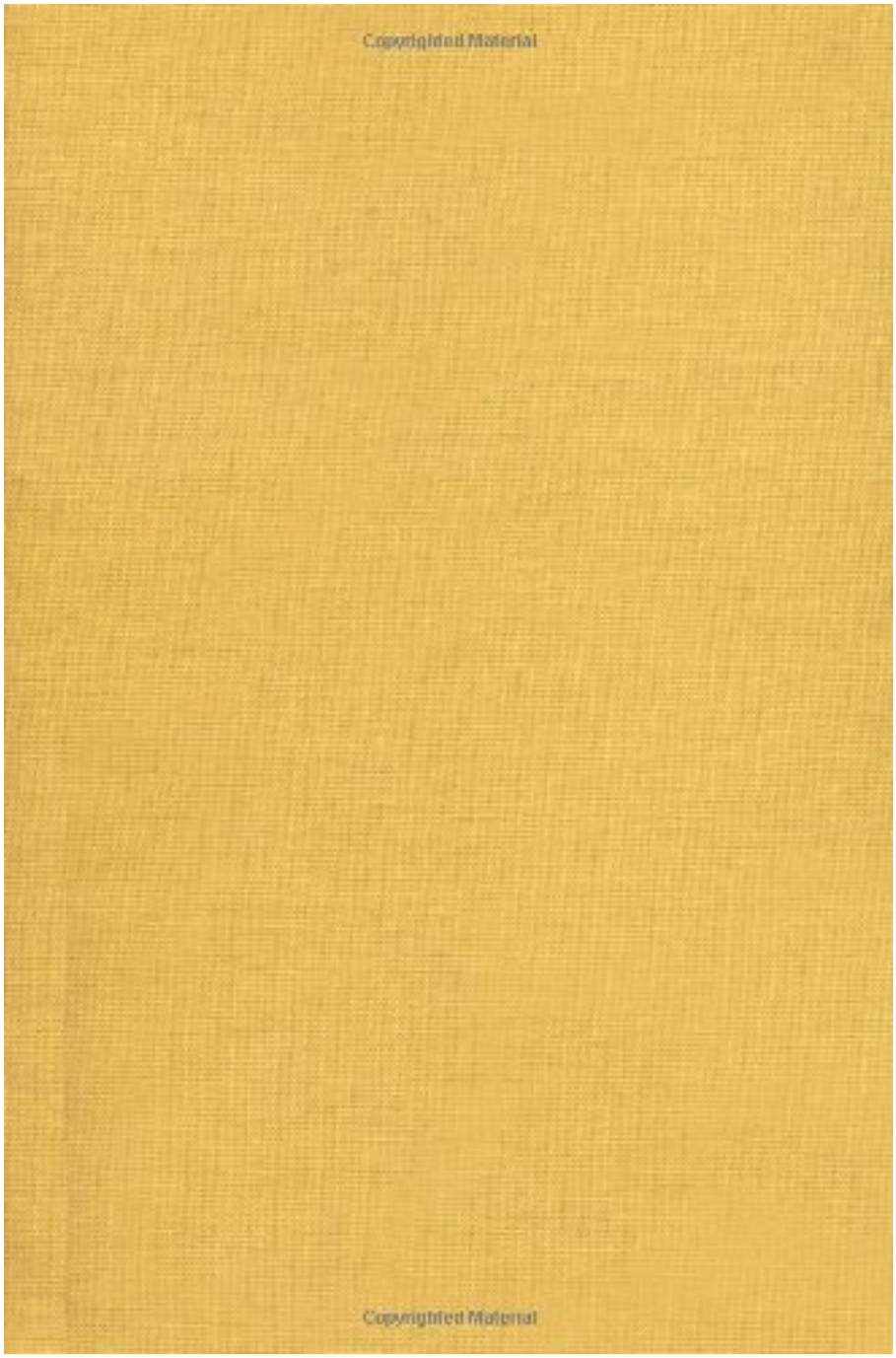

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Modern scholarship has exposed the intrinsic importance of medieval science and confirmed its role in preserving and transmitting Greek and Arabic achievements. This Source Book offers a rare opportunity to explore more than ten centuries of European scientific thought. In it are approximately 190 selections by about 85 authors, most of them from the Latin West. Nearly half of the selections appear here for the first time in any vernacular translation. The readings, a number of them complete treatises, have been chosen to represent "science" in a medieval rather than a modern sense. Thus, insofar as they are relevant to medieval science, selections have been drawn from works on alchemy, astrology, logic, and theology. Most of the book, however, reflects medieval understanding of, and achievements in, the mathematical, physical, and biological sciences. Critical commentary and annotation accompany the selections. An appendix contains brief biographies of all authors.This book will be an indispensable resource for students and scholars in the history of science.

- Sales Rank: #2055132 in Books
- Brand: Brand: Harvard University Press
- Published on: 1974-01-01
- Ingredients: Example Ingredients
- Original language: English
- Number of items: 1
- Dimensions: 10.36" h x 1.89" w x 7.34" l, 3.53 pounds
- Binding: Hardcover
- 884 pages

Features

- Used Book in Good Condition

About the Author
Edward Grant is Professor of History of Science, Emeritus, at Indiana University, Bloomington.

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Science From Above 100 AD To Below 1700 AD - Scientific Works From The Middle Ages By Medieval Scientists In Their Own Words
By Scholastic Reader
Edward Grant, who is a high caliber researcher of medieval sciences, does it again in compiling the best anthology of medieval science which spans more than 190 selections from about 85 authors that are from the time frame of second century AD to the seventeenth century AD with the earliest being the writings of Ptolemy and the latest being those of Galileo. This anthology has authors from European (Christian) and Middle Eastern (Muslim) cultures. This anthology of primary sources has much depth and scope to satisfy

empirical researchers on the history of the natural and social sciences. This anthology includes very extensive and rigorous footnotes which lead to other primary sources that are not found in this anthology and also section and author introductions are available to shed context to the discussed topics. One of the best parts of this text is that there are retentions of original terminology (Latin, Greek, Arabic) in certain sections and the editor does an excellent job in defining terminologies from their respective languages to capture the cultural context of the authors writing.

The ancient world and the middle ages had already set the foundations with which modern science was able to emerge. Even the Scientific Method was developed in the 1200s AD (Robert Grosseteste and Origins of Experimental Science, 1100-1700). Some of the factors that slowed the research before the age of the modern sciences actually had to do with accessibility of writings for medieval and ancient researchers. It must be noted that before the printing press in 1440, ALL of the scientific writings were copied by hand and with this came many difficulties of research. An average medieval scientist had to be able to read and write in multiple languages, translate to multiple languages, preserve manuscripts, generate manuscripts, compose works by hand, etc. Sometimes they had to make their own writing utensils and their own paper on top of trying to do research to advance their knowledge of natural phenomenon. All of this was very tedious and time consuming labor just to read the previous research from previous scientists and advance their positions concerning natural phenomenon. Also it would seem that usually wealthy people had access to writings and also that renting of manuscripts was common practice among scholars during the 1,000 years of the Middle Ages. But still scientists continued to break barriers and advance ideas and positions that we, today, think were "modern" advancements from the "Scientific Revolution". Once the printing press emerged the speed of research increased incredibly since people had cheaper reliable copies of writings and accessibility allowed for faster distribution of scientific literature. For information on the technological advancements that occurred during the Middle Ages and how some of these inventions really advanced science to another level that allowed for future generations to advance science to the modern age please read Cathedral, Forge and Waterwheel: Technology and Invention in the Middle Ages, Science and Technology in Medieval European Life (The Greenwood Press Daily Life Through History Series: Science and Technology in Everyday Life), Muslim contributions 1001 Inventions: Muslim Heritage in Our World, Chinese contributions The Genius of China: 3,000 Years of Science, Discovery, and Invention. It is known that usually science advances when technologies advance - and technologies advance generally because of pragmatism, need, and availability of resources (i.e. ancient China).

From this reading this sourcebook and other anthologies, one can clearly see that "religion" and "science" were never in conflict since science was seen as a "handmaiden" to theology. In fact, both were complimentary to each other. Contrary to popular belief of the "Dark Ages", which has been discredited by historians of science, Syrian Christians from Eastern Europe such as Nestorians and Monophysites were the ones that translated much of the important Greek science texts from Greek to Syriac and later on they translated many of these works into Arabic and other languages under Islamic rule. Eastern Christianity was a Hellenizing force which continued to spread Greek ideas to other regions after the Fall of Rome. This is how Muslims received many of the Greek scientific works. The work of the Eastern Christians pretty much preserved much of the Greek science in Arabic, which later on, was returned to the Latin West and thus much previous scientific knowledge was recovered and built upon as usual.

This was the ancient and medieval view, contrary to the modern perceptions that were created and mythologized by White and Draper in the late nineteenth century.

A typical example of historian mythology is that many believed the earth to be flat. This is incorrect, read "Inventing the Flat Earth: Columbus and Modern Historians" by Jeffrey Burton Russell and even read a very popular medieval encyclopedia called "Isidore of Seville's Etymologies: Complete English Translation" (2

Vol.) to clarify the issue.

From this anthology it is clear that ancient mathematics The Mathematics of Egypt, Mesopotamia, China, India, and Islam: A Sourcebook (usually via Euclid "Euclid's Elements" and sometimes through Archimedes "The Works of Archimedes"), early sciences (usually via Aristotle's complete works and the works of other early Greek scientists A Source Book in Greek Science (Source Books in the History of the Sciences)), astronomy (usually via Ptolemy's model Ptolemy's Almagest or Aristotle's comments), medicine (sometimes via Galen - Selected Works (Oxford World's Classics) and Hippocrates - "Hippocratic Corpus"), and natural history (usually Aristotle) have all played an important role in the advancements of science in the Middle Ages so anyone who is interested in some of the background for the writings of the anthology can read some of these primary sources to see a more complete historical context of the development of the sciences through the time. The Dialogue of Civilizations in the Birth of Modern Science pins the transcultural ideas that were used by Europeans that brought about modern science.

The following primary sources and academic writings add more historical context to these times and beyond:

"The Crisis of Church and State: 1050-1300, with selected documents (Medieval Academy Reprints for Teaching, 21)" (actual primary sources from this time period which laid the foundations of the modern view of the state and the concept of "secular". This impacted natural philosophy (the sciences) to a significant degree and thus is relevant)

"The History of Science and Religion in the Western Tradition: An Encyclopedia (Garland Reference Library of the Humanities)" edited by Gary Ferngren (diverse perspectives from historians of science and flow of ideas)

"Science and Religion, 400 B.C. to A.D. 1550: From Aristotle to Copernicus" by Edward Grant

"The Beginnings of Western Science: The European Scientific Tradition in Philosophical, Religious, and Institutional Context, Prehistory to A.D. 1450" by David Lindberg

Concerning the anthology being reviewed, I will simply cite a few things per section that are included or discussed (this list is not exhaustive and more material is mentioned in the source book than what I list below):

---------- Early Middle Ages ----------

The Latin Encyclopedists:
Here is a compilation of works from notable encyclopedists such as Isidore of Seville (570 - 630 AD), Boetheus (480 - 524 AD), and others who discourse over the nature and foundations of arithmetic and geometry, music, size of the sun and moon, solar and lunar eclipses, the hemispheres of the earth (implying sphericity of the earth), order of stars and planets and their motions, the nature of atoms and the elements, issues in weather conditions (thunder and rainbows), oceans and tides, and much more. These selections are very diverse and they summarize many theories and views that were popular in the early medieval period up to 1000 AD. Some theories remained popular after this period.

---------- Later Middle Ages ----------

The Translations of Greek and Arabic Science into Latin:
Mainly documents a series of works that were translated to Latin by one of the best translators of the time,

Gerard of Cremona (1114 - 1187 AD), who is responsible for passing much of Arabic science to Latin. Also William of Moerbeke (1215 - 1286 AD), who was one of the best translators of Greek writings to Latin, has a list of writings he translated.

Reaction of the Universities and Theological Authorities to Aristotelian Science and Philosophy:
Mainly documents from early universities on objections to some claims made by Aristotle in his views of nature.

Classification of the Sciences:
Documents on Medieval divisions of the sciences, theology, mathematics, and other arts.

Logic:
William of Ockham (1280 - 1349 AD) has a log discourse of the word "suppositio" and its divisions, the types of "terms" used in descriptions of things, and names.

Mathematics:
Roger Bacon's (1219 - 1292 AD) argument on the necessity mathematics in the study of logic and the sciences and how all things can and should be known through mathematical functions, which are a practice in basic reasoning.

Arithmetic:
Basic introductions to the nature and propositions of arithmetic.

Algebra:
Al Khwarizmi's (813 - 833 AD) work on the principles of algebra includes discourse and calculations on square roots and squares of numbers with geometrical demonstrations. Jordanus of Nemore's (1230 - 1260 AD) selection gives wordy algebraic propositions, that when made to variables, are easier to see how unknown variables would be solved.

Number Theory, Probability, and Infinite Series:
Leonardo of Pisa (1179 - 1240+ AD) and Nicole Oresme (1325 - 1382 AD) mainly generate propositions based on analysis of infinite sequences and Euclidean commentaries.

Proportions:
Campanus of Novara's (1296 - 1298 AD) commentary on one of Euclid's writings discusses and studies Euclidean ratios and proportions. Nicole Oresme's selections are on exponents and rules on adding, subtracting, reducing, etc. of rational and irrational ratios along with exponents.

Geometry:
Discourse on divisions of shapes that were sometimes in similar spirit to Euclid's divisions, two versions of Archimedes' squaring of circles, and a selection from Banu Musa (sometime in the 9th century AD) which discusses the splitting of an angle into 3 equal divisions. Other topics are discussed in the rest of the section.

Trigonometry:
Richard of Wallingford (1292 - 1336 AD) explains the use of the sine function with geometrical propositions and astronomical methods using Ptolemy's Almagest as a source.

Typical Scientific Questions Based On Aristotle's Major Physical Treatises:
Here there are selections that show some types of questions scientists were asking concerning nature and

Aristotle's views. Topics include types of motion, knowledge of causes, matter, chance as a mechanism of action, infinite dimensions, infinite bodies, time, changes in dynamics of motion, natural mobility, compounds, etc.

Statics, Motion, Kinematics, and Dynamics:
The selection of Jordanus Nemore shows some of the earliest works on vector statics in similar spirit to Isaac Newton's work in the "the Principia". Here there are many statics problems that are tackled via geometrical approaches. The selections on kinematics and dynamics by Gerard of Brussels (13th century) and Nicole Oresme provide geometric demonstrations on treating changing velocities to uniform velocities and also a geometric proof of the mean velocity theorem. There are also discussions found here on Aristotle's views on motion and commentary by Ibn Rushd (1126 - 1198 AD), also known as Averroes. Ibn Rushd's rebuts the criticisms of Avempace, who argues that the ratio of water and air in density does not equal to the ratio of the velocities of a stone traveling in the medium of water and air. Ibn Rushd also comments on causes in natural motions in another selection. Thomas Aquinas' (1225 - 1274 AD) selection on Aristotle's views on motion is interesting to read since here he is extending his thinking to the natural sciences. Albert of Saxtony (1316 - 1390 AD) has some things to add to the discourse on internal and external resistances in moving objects. Other things are found in these sections such as discourses on projectile motions, mathematical representations of motion, the causes of continuous motion and acceleration, and more. Galileo Galilei (1564 - 1642 AD) has one selection in this section.

Atomism:
Here the section is self explanatory in the development and objections to early atomic theory by some representative scientists. John Duns Scotus (1266 - 1308 AD) makes some interesting geometric proofs against atomism that indivisible things like atoms cannot compose an actual continuum.

On Vacuum:
Here there is a lot to see in the debates on whether or not vacuums (which are a space with no bodies) can really exist in reality. Issues on motion within voids are also considered. Many argue that nature attempts to fill voids with bodies, thus no vacuums really and others argue for partial or momentary voids. But they seem to agree that voids can be created by God if it was so desired and this kept up the possibility of an actual vacuum potentially existing through the Middle Ages.

Magnetism:
Here the properties of something called a Lodestone, which is simply magnetic magnetite, is discussed. The experiments done here and the ways to identify the poles of the Lodestone show early studies in magnetism at their best. There is discourse on how to use a Lodestone to make compass.

Optics:
Here there is much to look at in terms of the history of optics as a field. Much of the selections involve discourse on the nature of sight including discourse on the shape and anatomy of the eye. One selection involves studies in rainbows. Robert Grosseteste (1168 - 1253 AD) has an extensive selection which characterizes his influence on the retreatment of optics as a viable and significant field of study. Roger Bacon has a selection where he looks at the nature of light, speed, and geometric properties. Al-Haitham (965 - 1039 AD), known in the West as Alhazen, has a selection on the eye and the lens and a selection on the debate on visual rays (where something like rays are projected onto an object from the eyes). Roger Bacon also has a selection concerning visual rays. John Pecham (1230 - 1292 AD), Al-Haitham, Roger Bacon, and others have selections on geometrical aspects of vision, reflections, refractions, and images. There one data table that will be of relevance.

The Elements of Astronomy, Astrology, Cosmology:
Here there are two handbooks that were used as accounts of astronomical bodies, sphericity of the earth location of the earth among the other planets, immobility f the earth, centrality of the earth, the movement of the sun and the moon, geographical locations of the Tropics of Cancer and Capricorn, causes of lunar and solar eclipses, etc. The Alfonsine Tables, which are used in conjunction with Ptolemy's "Almagest", are found here. These were used to predict eclipses, locations of planets, etc. Nicole Oresme's counterarguments against astrology shed much light on the field of astrology and how some parts of astrology were empirically based and reliable. There are many selections in this section on whether or not the earth is rotating and if the movement can be detected fro our vantage point, including selections by Thomas Aquinas, Ptolemy, and Nicolaus Copernicus (1474 - 1543 AD). These shed light on how rigorous scientists were on these issues and what how many lines of evidence were used to argue for both positions. Once more accurate information could be gathered by a telescope the debate was settled. Discourse on comets and plurality of worlds are also included.

Alchemy and Chemistry:
These selections of alchemy show how chemistry was developing since the ancient world and how questions of matter and the notion of elements, usually Aristotle's view of 4 elements impacted studies in transmutations of substances. Alchemy involved way more than just the Philosopher's Stone and scientists were tying to forge and synthesize metals. Petrus Bonus' selection of counter arguments against alchemy and the responses to the objections to alchemy add excellent context to the practice of alchemy. Here too, Thomas Aquinas makes a contribution to how compounds form.

Geology, Geography, and Oceanography:
These selections sound pretty modern in their synthesis of the formation of land masses and natural forces that have "carved" the face of the earth.

Zoology, Botany:
These selections are on the nature and description of beasts and plants and their classifications. Some of the individual parts of plants are discussed too by Albertus Magnus (1193 - 1280 AD).

Anatomy, Methods of Diagnosis, Treatment of Particular Ailments, Tools Employed in Treatment, Surgery:
Here there are many selections that show the influence of Galen and others. Of interest may be the selections of Mondino de Luzzi (1265 - 1326 AD) where human dissection is the means he uses to describe the human anatomy and Bernard Tornius (1452 - 1497 AD) on autopsies. Another selection that may be of interest here would be Heinrich von Pfolspeundt's (around 1460 AD) account on plastic surgery. The rest of the selections discuss understanding of sexual organs, diseases, drugs, diets, etc.

It should be clear, after reading this anthology, that many modern popular scientific mythologies such as "educated people in the 'Dark Ages' believed the earth was flat", "Modern Science has thoroughly abandoned ideas from the middle ages and the ancient world", "the scientific method(s) began to be used at the time of the 'Scientific Revolution' ", "no scientific research was done in the Middle Ages" are completely wrong and debunked since the continuity of thought, via antiquity and the middle ages, is clearly seen in these passages. Much of the base scientific knowledge from today was known back then, despite the limitations of transmission and resources. For example, studies of beasts in zoology, realm of anatomy and disease, plastic surgery, the sphericity of the earth, vector analysis of forces, geometry, infinite series, uniformitarian geology, atomic theory, and much more. From the Renaissance to the 20th century, many scientists viewed and imagined people from the Middle Ages to be very superstitious and ignorant, however the modernity and research found in the passages in the anthology proves otherwise.

Bravo to Edward Grant and the Medieval scientists! This work really deserves a wide audience.

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About the Author
Edward Grant is Professor of History of Science, Emeritus, at Indiana University, Bloomington.

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