Medieval Scholars and the Scientific Method

Modern students who are accustomed to the idea that the physical world can be analyzed and understood sometimes have difficulty seeing the mysteries of nature at they appeared to our forefathers. Ideas that seemed reasonable and consistent to medieval scientists, such as Aristotle's theory that all matter was composed of "Earth, Water, Air, and Fire", strike modern thinkers as naive. Many theories about nature held by medieval scholars were simply untrue, but they were widely accepted because they were logically consistent and men of their age had no way of proving or disproving them.

Robert Grosseteste, Albert the Great, and Roger Bacon, are the scholars most associated with formulating the 'Scientific Method' during the 12th and 13th centuries. All three wrote on the importance of observation and methodical study but they did not consider these things particularly novel or revolutionary. Experimentation was not unknown to the medieval world, and in fact **Alchemy**, an entirely experimental occupation, was widely practiced both by respected scholars such as themselves, and by magicians and charlatans.

In situations where Ancient scientists were able to verify their theories, they did not shrink from experimentation. Archimedes, for example, performed many experiments to test his laws of displacement, and Eratosthenes masterminded a brilliant means of estimating the size of the earth, involving advanced knowledge of geography, surveying methods, trigonometry, and astronomy.

The problem with ancient science was not so much that scholars scorned experimentation, but that many speculations regarding the natural world were untestable. For example, the atomic theory of matter was discussed by Democritus as early as 400 B.C., but he had no way of verifying his hypothesis. The problem with so many untestable theories, however, was that there was little pressure to verify even those ideas which could be proven. The scholars who established the 'Scientific Method' in Western science understood that whenever possible, experiments and systematic observations were necessary to determine the truth of scientific theories. Their work helped encourage future scientists to think clearly about what could and could not be proven, and wherever possible, to distinguish between proven fact, and speculation.

Natural Philosophers of the 13th Century

Virtually all the early Natural Philosophers were Monks or Clerics. Laymen did not take a predominant role in the study of Natural Science until Schools and University systems were well established. During the 13th century, Dominicans and Franciscans were active in Scholarly and Teaching pursuits.

Thierry of Chartres *(12th century)*	French abbot and scholar of Natural philosophy who wrote an encyclopedia including the best scientific knowledge of his age. He tried to reconcile Aristotelian logic while upholding the truth of the Genesis story of creation.
Robert Grosseteste *(c. 1175 – 1253)*	English Bishop who was one of the most knowledgeable men of the Middle Ages; Helped establish the scientific method by writing down a complete set of steps for performing a scientific experiment.

Vincent of Beauvais *(c.1190–c.1264)*	Dominican Friar who wrote the most influential encyclopedia of the Middle Ages including chapters on light, the heavens, human anatomy, the elements, and the sea, land, and wildlife.
Albertus Magnus *(c. 1206–1280)*	Dominican friar and Bishop of Regensburg who was highly respected scholar at the University of Paris and teacher of Thomas Aquinas. Patron saint of natural sciences; Works in physics, logic, metaphysics, biology, and psychology.
Roger Bacon *(c. 1214–1294)*	Franciscan scholar from Oxford who made significant contributions to mathematics and optics and has been described as a forerunner of modern scientific method.
William of Ockham *(c. 1288-1348)*	Franciscan scholar who wrote significant works on logic, physics, and theology; known for Occam's razor principle, that a simple explanation should be preferred to a complicated one. He is also known for proposing that outer space was a vacuum (without friction).

Timeline of the Scientific Method

The rise of scientific thinking and scholarly thinking and research in general arose in the 12th and 13th centuries. Three factors that contributed to this was the reform of the monasteries recently begun by the Cluniacs and Cistercians, the rise of the Universities and scholarly communities, and the availability of Latin translations of Aristotle on scientific topics. This led to a rebirth of interest in science and philosophy in the 12th century, particularly in Western Europe.

- **1100~** — Rise of Universities, especially at Paris, Oxford, and Bologna.
- **1150~** — Latin translations of the works of **Aristotle's Physics** created from Arab manuscripts.
- **1200~** — Aristotle's ideas (four causes, four elements, form, matter, and soul) greatly influenced Christian scholarship.
- **1230** — **Robert Grosseteste**, scholastic philosopher and bishop, published scientific commentaries on astronomy, light, and mathematics, which laid out the framework for proper methods of science.
- **1265** — **Roger Bacon**, Franciscan monk from Oxford, described a cycle of observation, hypothesis, and experimentation while recording his methods in precise detail so that others could reproduce them.
- **1274** — **Thomas Aquinas** publishes 'Summa Theologica' which attempts to synthesize Aristotelian logic with Christian principles.
- **1277** — The Bishop of Paris issues **Condemnation of 1277**, were enacted to condemn various points of Aristotle's Physics as being heretical and incompatible with the Christian faith. These condemnations forced scholars to reject many of Aristotle's interpretations and seek alternate explanations. Condemned principles included:
    1. World was eternal, not created, 2.There were no first human parents 3.God was remote and impersonal; 4. Human souls are mortal; 5. There is no Divine Providence.
- **1327** — **William of Ockham** wrote a critique of Aristotle's Physics that put forth **Ockham's Razor** principle, which states that among competing hypotheses, the simplest one with the fewest assumptions should be selected.