

Sir Francis Bacon,
Lord Verulam,
Viscount St. Alban

(1561-1626)

Lord Chancellor (1618-1621)



Outline

- Background
 - Scholasticism
 - Humanism
 - Bacon's Objection to Scholasticism
- Bacon's Vision and Goals
- Key Works
 - *De Augments Scietiarum (The Advancement of Learning)*
 - *Novum Organum (The New Method)*
- The Impact of Bacon's Works

Roots of Scholasticism

- “Carolingian Renaissance” (c. 800 CE)
- Charlemagne needed “educated” scribes and clergy
- Monastery & cathedral schools
- Trivium - grammar (Latin), logic, and rhetoric
(Bachelor ~3 years)
- Quadrivium - arithmetic, music, geometry, and astronomy
(Master ~ 4 years)

Universities & Scholasticism

- Prior to 12th century, limited knowledge of Aristotle's works in West
 - Roman commentaries (c. 510-520 CE) on *Organon* (Method or Tool)
 - Works preserved in the East – Byzantium and Islamic world
- Growth of universities in Europe began c. 1090 CE
- Scholasticism – System of theology & philosophy taught in universities
 - Curriculum – based on trivium & quadrivium
 - Instruction – lectures and “disputations”
- “Disputation” – Use of Aristotle's dialectic reasoning and deductive (syllogistic) logic to debate and resolve a question
 - At great length – in minute detail – often involved semantics

Disputation

- Question posed
- Effort to reconcile human reason & works of classical philosophers with revealed theology
- Accepted revealed theology
- Contradictions were resolved in disputations
- Contradictions always resolved by reconciliation with revealed theology

Humanism

- Classical texts discovered in monastic libraries in Italy (c. 1300 CE)
- Collections of classical works - Petrarch (1304-1374) and Boccaccio (1313-1375)
- Fall of Constantinople (1453 CE)
- Secular humanism - Italy
- Christian humanism – Northern Europe (c. 1500 CE)
- Reformation (beginning ~ 1517 CE)
- Humanism in England - dissolution monasteries (1536 CE)

Scholasticism remained the basis of education well-into the 17th century

Bacon's Objection to Scholasticism

- Scholasticism still the basis of education when Bacon attended Cambridge (1573-1576)
- Bacon developed strong objections to scholasticism
 - Its dependence on Aristotelian dialectic reasoning and syllogistic logic
 - Its adherence to **received knowledge**
- Bacon believed this led to intellectual stagnation

Recurring theme which appears in the writings of Bacon (1561-1626), Descartes (1596-1650), Locke (1632-1704), and Newton (1643-1727) among others.

Early Statement of Vision and Goals (1592 CE)

- Bacon's strong objections to scholasticism, etc.
- Letter to his uncle, Lord Burghley
 - Interest in knowledge
 - Objections to disputations, blind experiments & traditions (received knowledge)

*I confess that I have as vast contemplative ends, as I have moderate civil ends: for I have taken all knowledge to be my province; and if I could purge it of two sorts of rovers, whereof the one with frivolous disputations, confutations, and verbosities, the other with blind experiments and auricular traditions and impostures, hath committed so many spoils, I hope I should bring in **industrious observations, grounded conclusions, and profitable inventions and discoveries**; the best state of that province.*

Thoughts and Conclusions (c. 1603 CE)

- Condemned the superstitious ways in which natural philosophers and physicians placed artificial limits on what could be achieved
- Lambasted adherence to outdated system of thought
- Anyone who argued with certain authorities or raised awkward questions was censured as a *disturbing and revolutionary influence*

*De Augmentis Sciendarum -
The Advancement of Learning (1605)*

- Arguably the first important philosophical work published in English.
- Credited as pioneering essay in support of empirical philosophy.
- Significant expansion on the themes in *Letter to Uncle* (1592) and *Thoughts and Conclusions* (1603)

The Advancement of Learning - 3 Distempers of Learning

1. Fantastical Learning – Pseudo-science of occultists and charlatans
2. Contentious Learning - Aristotelian philosophy, theology and the Scholastic tradition
 - Logical hair-splitting and metaphysical quibbling;
 - Any intellectual endeavor in which the principal aim is endless debate cherished for its own sake versus knowledge and understanding
3. Delicate Learning – Preoccupation with *words more than matter*, with *choiceness of phrase* and the *sweet falling of clauses* – in short, with style over substance

The Advancement of Learning

Eleven Peccant Humours of Learning

- Bondage to the past: over reliance and emphasis on the thought and works of antiquity
- Focus on reason rather than observations
- Drawing conclusions without sufficient data and analysis.
“If a man will begin with certainties, he shall end in doubts; but if he will be content to begin with doubts, he shall end in certainties.”
- Scholasticism
- Focus on interpreting and commenting on extant science rather than adding to it.
- Mistaking the purpose of knowledge – Benefit of mankind vs some self-serving reason

The Advancement of Learning

The True Dignity & Value of Learning

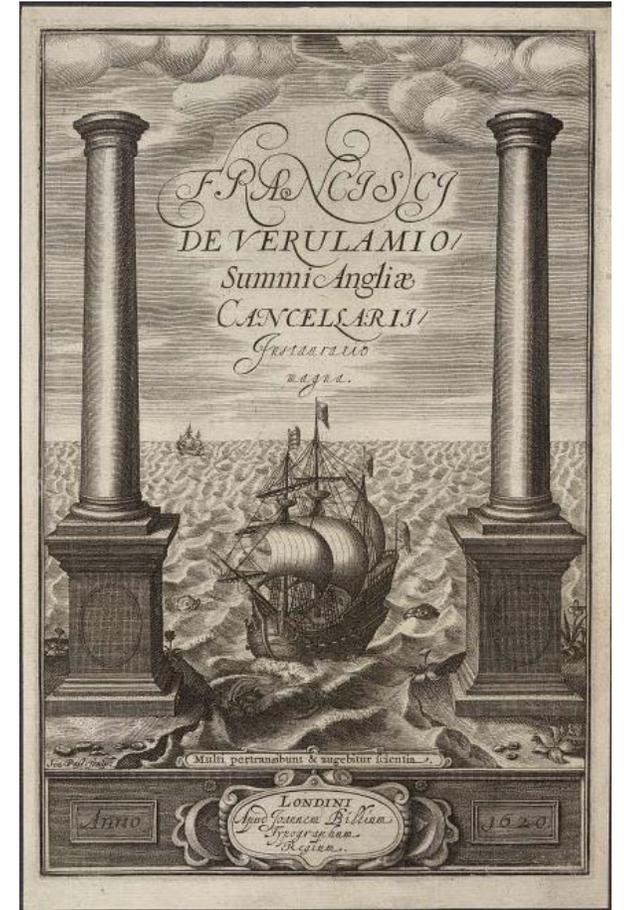
- Ecclesiastical Perspective:
 - Examples **from ecclesiastical works**;
 - Moses, Solomon, and the Jesuits
- Human Perspective:
 - Examples of various **historical, imperial and military leaders**;
 - Compares Nerva, Trajan, Hadrian, Antonio Pius and Marcus Aurelius to Commodus: Nerva-Antonine dynasty (96-192 CE)
- Moral & private virtues of learning:

*“Scilicet ingenuas didicisse fideliter artes
Emollit mores nec sinit esse feros.” **

**Rough translation – Of course the liberal arts soften the manners of the savage*

Instauratio Magna Scientiarum – The Great Restoration of Science (1620 CE)

- Purpose: *to commence a total reconstruction of sciences, arts, and all human knowledge, raised upon the proper foundations*
- Initial plan was for 6 volumes.
- Only Volumes 1 & 2 completed at the time of Bacon's death in 1626 CE
- Volume 2, *Novum Organum* or *The New Method* (1620 CE)
- Volume 1, *De Augmentis Scientiarum* or *The Advancement of Science* (1623 CE)
 - Significant expansion of *The Advancement of Learning* (1605 CE)



Title page of the 1620 printing: A ship passing between the Pillars of Hercules

The caption below the ship is in Latin; It's taken from the book of Daniel (12:4);

"Many shall go to and fro and knowledge shall be increased."

*Novum Organum –
The New Method (1620 CE)*

- Reference to Aristotle's work *Organon*
- Divided into a Preface and two Books;
 - *Aphorisms Book I - On The Interpretation Of Nature And The Empire of Man*
 - Critique of contemporary natural philosophy
 - Explanation of Bacon's alternative method
 - *Aphorisms Book II - On The Interpretation Of Nature, Or The Reign Of Man*
 - Examples of applications Bacon's method

Novum Organum – Book I

- **Aphorism 1:** Knowledge and understanding of nature limited by observation and contemplation
- **Aphorism 2:** Experimental and intellectual tools are required to aide understanding
- **Aphorisms 5-10:** Current knowledge limited to things already discovered; no methods to make new discoveries
- **Aphorism 11:** *Just as the sciences that we now have are useless for devising new inventions, the logic that we now have is useless for discovering new sciences.*
- **Aphorism 12:** *The logic now in use serves rather to fix and give stability to the errors which have their foundation in commonly received notions than to help the search after truth. So it does more harm than good.*

Novum Organum – Book 1

Idols of the Mind

- Four *Idols of the Mind* - Impediments that interfere with clear reasoning, obscure truth, and restrict progress
 1. *Idols of the Tribe*: Errors in perception due to limitations of the human senses
 2. *Idols of the Cave*: Errors due to personal prejudices and particular styles or modes of explanation
 3. *Idols of the Market-Place*: Error due to vagaries of language
 4. *Idols of the Theatre*: Errors due to accepted philosophical dogmas – natural and theological – and existing methods

Novum Organum – Book I

- **Aphorism 50:** Limitations of Human Senses and the Need for Experiment
 - *All the truer kind of interpretation of nature comes about through instances and well-designed experiments: the senses pass judgment on the experiment, and the experiment passes judgment on nature, on the facts.*
- **Aphorism 95:** Experiment and Reason must be employed together
 - *Those who have handled sciences have been either **men of experiment** or **men of dogmas**. The **men of experiment are like the ant**; they only collect and use: **the reasoners resemble spiders**, who make cobwebs out of their own substance. But **the bee takes a middle course**; it gathers its material from the flowers of the garden and of the field, but transforms and digests it by a power of its own.....Therefore from a closer and purer league between these two faculties, the experimental and the rational, (such as has never yet been made) much may be hoped.*
- **Aphorism 100:** Improved Experimental Instruments and Techniques must be developed
 - *Many more experiments should be devised and carried out, and ones of an utterly different kind from any we have had up to now. But that is not all. There should also be introduced an entirely different method, order, and procedure for carrying through a programme of experiments. To repeat something I have already said: when experimentation wanders around of its own accord, it merely gropes in the dark and confuses men rather than instructing them. But when there is **a firmly regulated, uninterrupted series of experiments**, there is hope for advances in knowledge.*

Novum Organum – Book I

- **Aphorism 104:**
- Extant method: Produces misconceptions and errors
 1. Observed particulars
 2. Jump immediately to most general axiom – 1st principle (conclusion accepted as unshakable truth)
 3. Prove intermediate axioms by deduction (syllogistic logic)
- Correct method: Ascending a ladder of axioms
 1. Observed particulars
 2. Lower axioms – *differ but slightly from bare experience*
 3. Intermediate axioms - *true and solid and living axioms, on which depend the affairs and fortunes of men*
 4. Most general axiom, - *are notional and abstract and without solidity*

Novum Organum – Book I

Method of Induction

- Simple enumeration of affirmative instances is inadequate
- Need sufficient observations of contradictory instances
- Conclusion based on affirmative instances - axiom
- Determine whether axiom applies to observed particulars only, or has wider applicability
- If wider, test against new particulars
- Induction applies to both natural philosophy and particular sciences
 - astronomy, optics, music, many of the mechanical arts, and medicine
 - moral and political philosophy
 - logical sciences

Novum Organum- Book II

- Example – Form of Heat: Specific instances in nature

1. The rays of the sun, especially in summer and at noon.
2. The rays of the sun reflected and condensed, as between mountains, or on walls, and most of all in burning-glasses and mirrors.
3. Fiery meteors.
4. Burning thunderbolts.
5. Eruptions of flame from the cavities of mountains.
6. All flame.
7. Ignited solids.
8. Natural warm-baths.
9. Liquids boiling or heated.
10. Hot vapours and fumes, and the air itself, which conceives the most powerful and glowing heat, if confined; as in reverbatory furnaces.
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26. Strong vinegar, and all acids, on all parts of the body where there is no epidermis, as the eye, tongue; or on any part when wounded and laid bare of the skin; produce a pain but little differing from that which is created by heat.
27. Even keen and intense cold produces a kind of sensation of burning

The Impact of Bacon's Works

Challenge to Scholasticism

- Medieval Philosophers:
 - Prominent philosophers in Europe were theologians
 - Roger Bacon (1214 - 1294) – only one to openly oppose scholasticism
- Renaissance Philosophers:
 - Bacon - first to openly oppose scholasticism and provide a rationale alternative
- Subsequent philosophers (e.g., Hobbes, Descartes, Locke) rejected scholasticism; as did natural philosophers (e.g., Sir Issac Newton)

The Impact of Bacon's Works

- Scientific Method - Based on Bacon's method in *Novum Organum*
 - "Father of the Experimental Philosophy" (Voltaire - 1734)
- Scientific Revolution - Bacon provided philosophical underpinnings
- The Royal Society of London
 - Fundamental idea derived from Salomon's House introduced in Bacon's utopian novel, *New Atlantis*
 - Informal groups of physicians and natural philosophers meeting c. 1645
 - Royal Charter – 1662
 - Motto *Nullius in verba (take nobody's word for it)* - verified statements by experiment

The Impact of Bacon's Works

- The Enlightenment
 - Descartes – Founder of rationalist strain of the Enlightenment
 - Bacon - Founder of the empiricist strain of the Enlightenment
- British Empiricism - Influenced works of British Empiricist philosophers John Locke (1632-1704), George Berkeley (1685-1753), and David Hume (1711-1776)
- Kant – Preface to 1787 edition of *The Critique of Pure Reason*
 - Kant credits Bacon: *This method, accordingly, which we have borrowed from the natural philosopher, consists in seeking for the elements of pure reason in that which admits of confirmation or refutation by experiment.*