A painting depicting an alchemist in a workshop. The alchemist, a bearded man in a long, light-colored robe, is kneeling and holding a glowing, spherical flask over a stand. The workshop is filled with various alchemical apparatuses, including retorts, flasks, and a large furnace. The scene is dimly lit, with a warm, golden glow emanating from the flask and a small window in the background.

# Alchemy and Experiment in the Renaissance

Prof. David Kaiser

Wednesday, September 15, 2010, STS.003

# Matter unit

## *Overarching questions:*

Is the stuff of the world unchanging or transmutable?

How have the institutions of science evolved?

## I. The Renaissance and the Place of Learning

## II. Alchemy and Science?

*Reminder: Paper 1 due in class, Monday, 27 September*

**Readings:** Starkey, *Alchemical Laboratory Notebooks*, 127-129, 170-175;  
Boyle, *New Experiments Physico-Mechanicall*, preface, 20-37;  
Dear, *Revolutionizing the Sciences*, 127-144.

# Medieval Universities

The first universities in Europe were founded during the Middle Ages:

Bologna, 1088

Paris, ca. 1150

Oxford, 1167

Cambridge, 1209

Photo of the University of Bologna removed due to copyright restrictions.



Scholarship revolved around close readings of ancient texts (*Scholasticism*), especially Aristotle.

Laurentius de Voltolina, *Liber ethicorum*, ca. 1350

# The “Renaissance”

Beginning in the 14<sup>th</sup> and 15<sup>th</sup> centuries, scholars and artists throughout Europe began to proclaim a new era: a re-birth (“renaissance”) of learning.



Hans Holbein the Younger, *The Ambassadors*, 1533

Their goal: the wholesale revival of another culture; to imitate and recover the splendors of ancient Rome.

Ancient authorities needed to be rescued from centuries of poor translations and narrow-minded commentaries, which had *corrupted* the original vitality of classical texts.

# The Printing Press

Before the invention of Gutenberg's printing press, there were only a few thousand (manuscript) books in all of Europe. By 1500, there were *9 million* books in Europe alone.

Images of Gutenberg's printing press and "The Printing Press as an Agent of Change," Elizabeth L. Eisenstein, removed due to copyright restrictions.

# Renaissance Humanism

Another major impetus: the “fall” of Constantinople to the Turks in 1453. Many Byzantines fled into Europe, bringing scores of Greek texts with them.



Jean Joseph Benjamin-Constant,  
*Entry of Mehmet II into Constantinople, 1876*



*Renaissance Humanism: to collect, preserve, and compare extant copies of ancient authors, in order to produce corrected, definitive editions.*

Erasmus, Greek-Latin New Testament, 1516

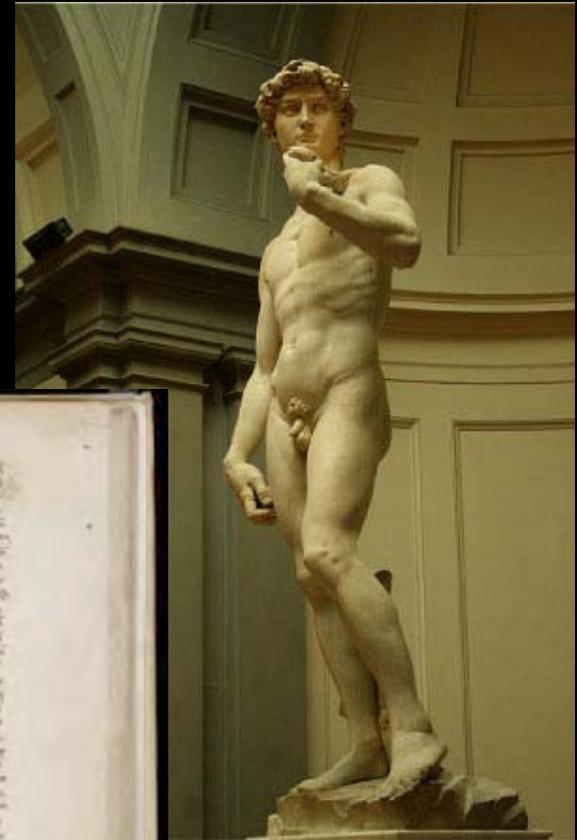
# Imitation is the Highest Form...



Leonardo da Vinci,  
*Vitruvian Man*, 1487



Petrarch, *Letter to Cicero*, ca. 1350



Michelangelo,  
*David*, 1504

Photo courtesy of jay8085 on Flickr.

# Princely Patronage

Photo of "The Prince," Niccolò Machiavelli,  
removed due to copyright restrictions.



Michele Castrucci, *Cosimo II de Medici*, ca. 1610

The 'new learning' was *not* centered in the universities,  
but was sponsored by wealthy (often royal) patrons.

# Alchemy and Science?

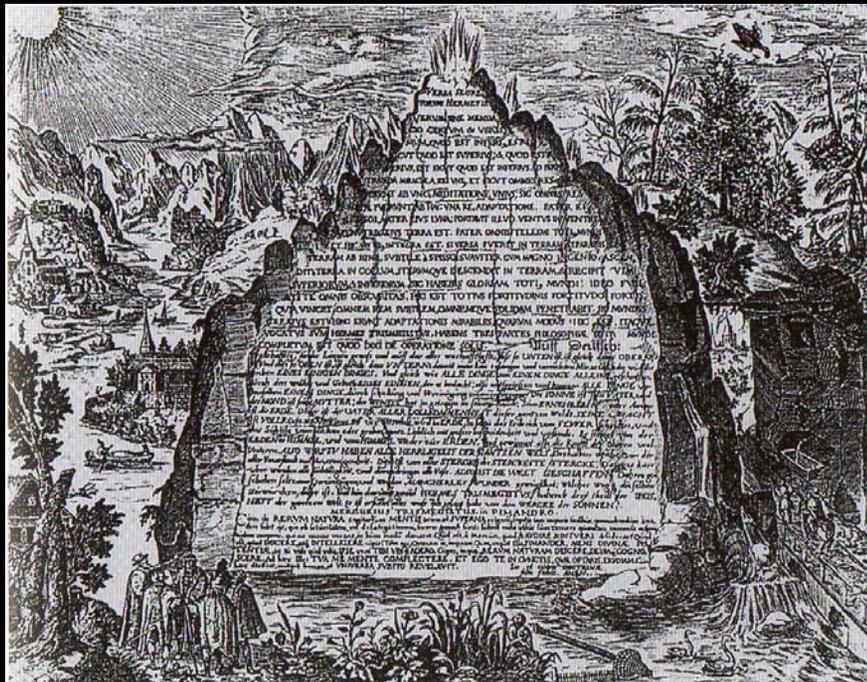
Alongside Renaissance Humanism, alchemy flourished in the 14<sup>th</sup> - 17<sup>th</sup> centuries. They shared several traits:

Alchemists sought to revive the true learning of the ancients, which had become obscured and corrupted over time. And they sought to unite contemplation with practical action.



David Teniers, *The Pleasure of Fools*, ca. 1650

# Recover Lost Learning



This image is public domain.



Floor mosaic depicting Hermes Trismegistus, Sienna Cathedral

Alchemists pored over the “Emerald Tablet” and other writings of “Hermes Trismegistus” to unlock their hidden meanings. They interpreted the riddles as *recipes* for specific chemical reactions.



# Occult Attractions

Many alchemists adopted a panvitalist view: matter itself was in some sense alive.



Anon., *The Twelve Keys of Basil Valentine*, 1599

They spoke in anthropomorphic terms: lead “wants” or “desires” to transmute into gold; antimony feels a wilful “attraction” to silver, and so on.

# The Philosopher's Stone

Alchemists believed that all metals came from one common type of seed; their outward differences sprang from different developmental pathways from deep within the earth to its surface. Every metal *could have* turned into gold.

Image of "Harry Potter and the Philosopher's Stone." J. K. Rowling, removed due to copyright restrictions.

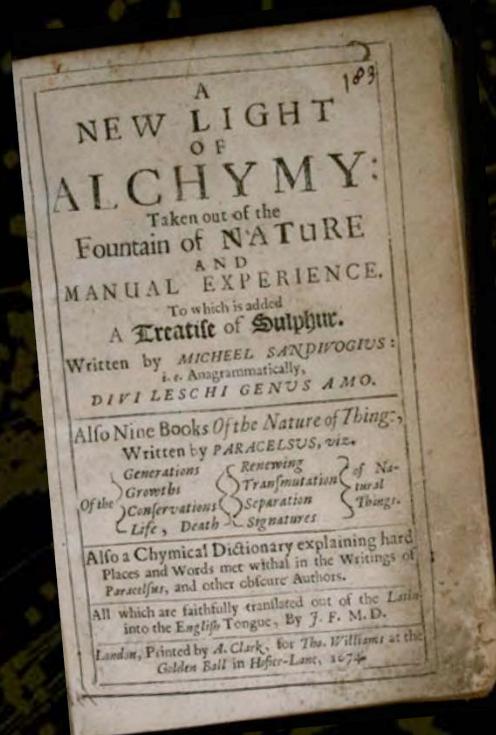
They sought the *Philosopher's Stone*: some means of reversing Nature's course and *transmuting* a "base" metal into pure gold. Such a means of generating perfection would also lead to the *Elixir of Life*.

# Alchemists at Court

Many influential alchemists worked for royal patrons. Michael Sendivogius (1556-1636) worked in Prague for Emperor Rudolph II.



Jan Matejko, *Alchemist Sedziwój [Sendivogius]*, ca. 1860



Sendivogius argued that air was a *mixture* – in fact, a crucial mixture, which held the secret of life – rather than a pure element (contra Aristotle).

# Illustrious Following

George Starkey (1628 - 1665) became another influential alchemist. Born in Bermuda (of Scottish parents), he moved to New England and attended Harvard College (class of 1646). He then moved to London and published many alchemical texts under the name "Eirenaeus Philalethes" (peaceful lover of truth).

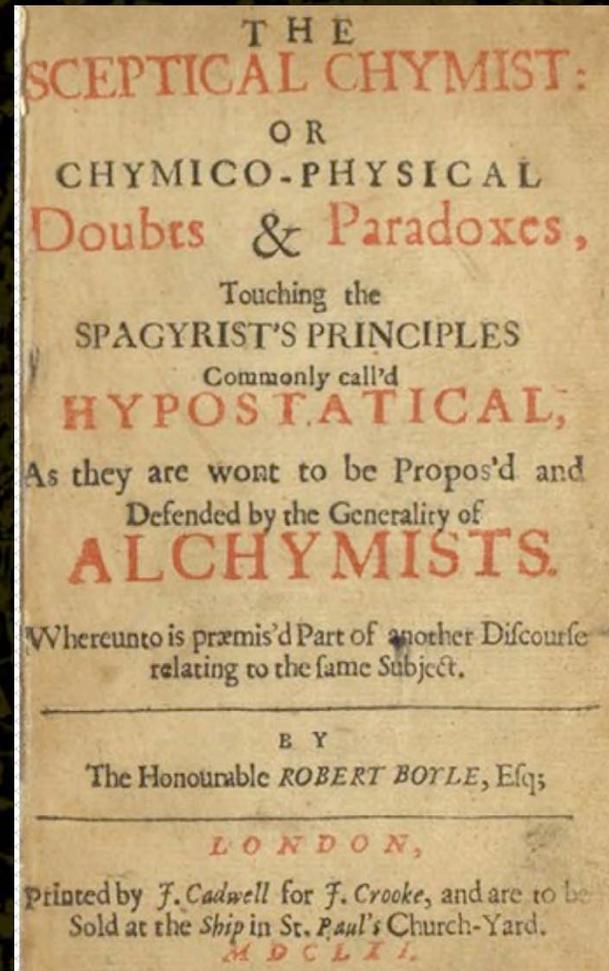
Image of "Gehennical Fire: The Lives of George Starkey, an American Alchemist in the Scientific Revolution," William R. Newman, removed due to copyright restrictions.

Starkey became the best-known and most-read North American scholar in Europe - on any topic - for a century, only to be eclipsed by Benjamin Franklin.

# Alchemical Students

Robert Boyle (1627 – 1691), “the father of chemistry,” was a student of George Starkey’s. Boyle’s first experiences in a laboratory likely came from Starkey’s tutelage in the 1650s.

Image of "The Aspiring Adept: Robert Boyle and his Alchemical Quest," Lawrence Principe, removed due to copyright restrictions.

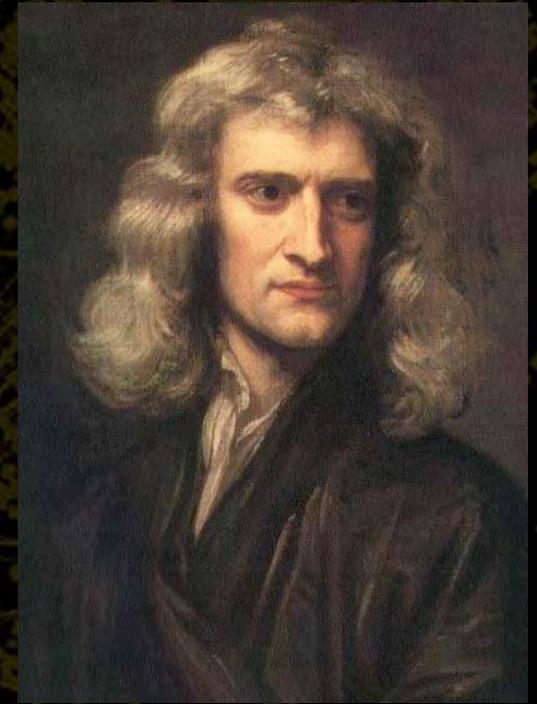


Despite public dismissals, Boyle worked tirelessly on alchemical transmutation to the end of his life.

# Alchemical Enthusiast

Isaac Newton was also an alchemical devotee. As a student he kept a notebook on his close readings of alchemical treatises. It included extensive notes on 150 different works.

Image of "Newton and the Counterfeiter: The Unknown Detective Career of the World's Greatest Scientist," Thomas Levenson, removed due to copyright restrictions.



Godfrey Kneller, portrait of Isaac Newton, 1689

Then he began his own alchemical experiments, amassing *10,000 manuscript pages*: more than his writings on mathematics and physics combined.

# Alchemical Legacy

Alchemy remains a strange hybrid to modern eyes: shrouded in secrecy, obscure riddles, and mysticism, it was also the major impetus for new experimental methods. It also provided the first serious challenge to Aristotelian matter theory in centuries.



Heinrich Khunrath, alchemical laboratory, 1609

Images of "Atoms and Alchemy: Chymistry and the Experimental Origins of the Scientific Revolution" and "Alchemy Tried in the Fire: Starkey, Boyle, and the Fate of Helmontian Chymistry," William R. Newman, removed due to copyright restrictions.

Alchemists introduced and refined basic laboratory techniques (distillation, sublimation, filtration, purification, catalysis, ...); emphasized quantification; and pursued systematic investigation of wide-ranging reactions.

# Revolutionary Times



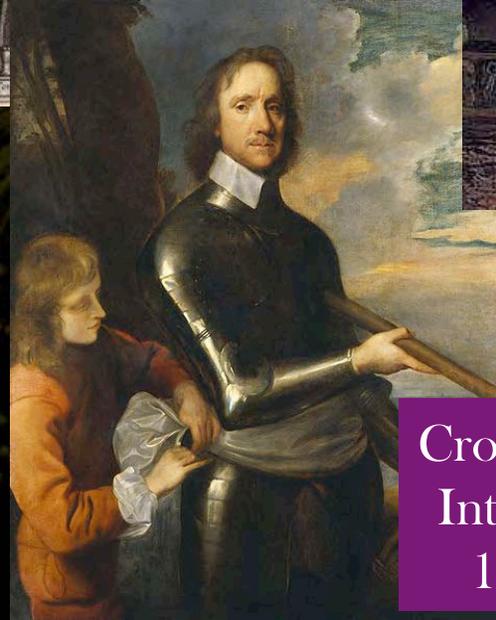
Daniel Mytens, *Charles I*, 1631

Charles I dissolved  
Parliament, 1629



German print,  
*Beheading of  
Charles I*, 1649

Civil War,  
1640-1649



Robert Walker, *Oliver Cromwell*, ca. 1650s

Cromwell rules  
Interregnum,  
1649-1658

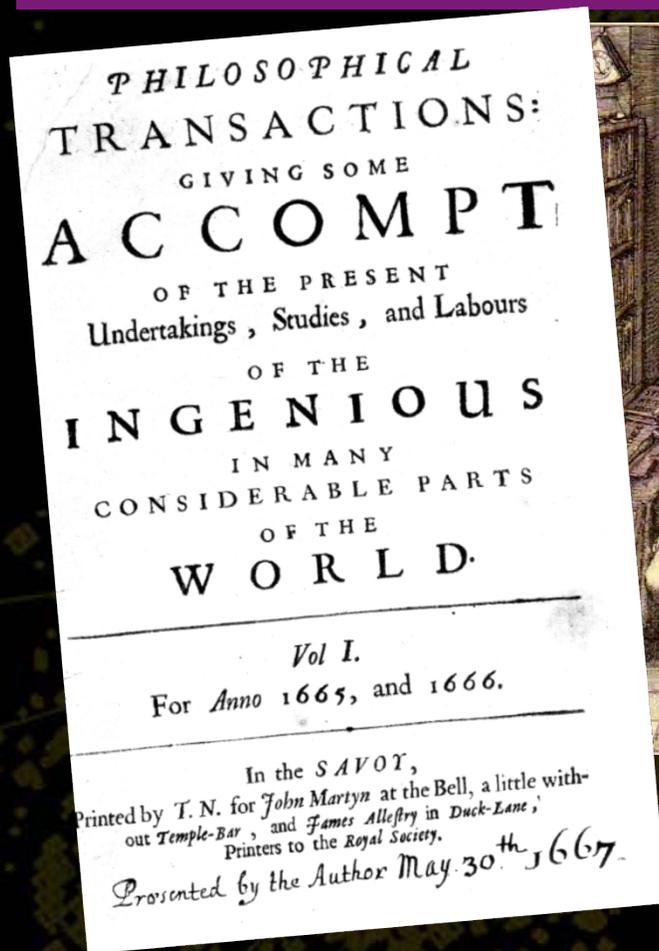
“Restoration”:  
Charles II  
coronated, 1660



John Michael Wright,  
*Charles II*, ca. 1661

# New Institutions

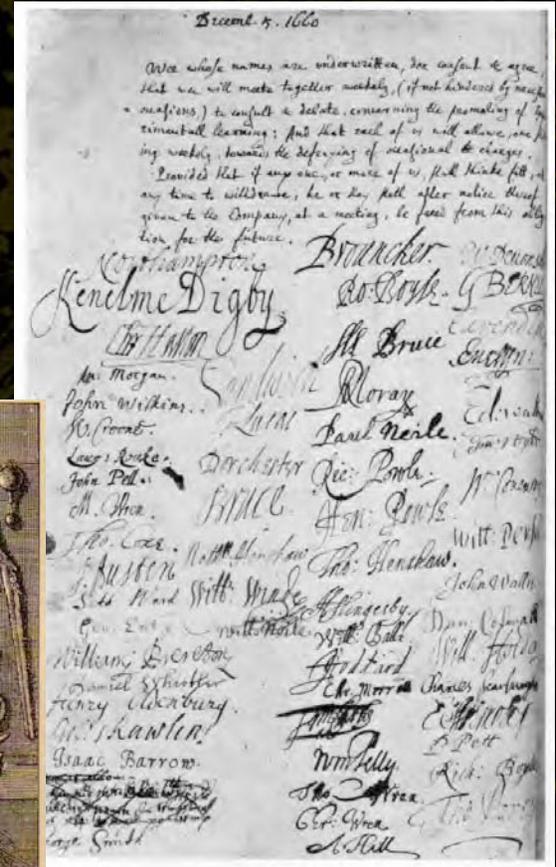
Royal Society of London,  
founded 1660



First issue of *Philosophical Transactions*, 1667



Frontispiece of Thomas Sprat,  
*History of the Royal Society*, 1667



Royal Society founding  
document, 1660

Image of "A Social History of Truth: Civility and Science in Seventeenth-Century England," Steven Shapin, removed due to copyright restrictions.

# Complementary Models



Joseph Wright, *The Alchemist in Search of the Philosopher's Stone*, 1771



Johan Kerseboom, *Robert Boyle*, 1689

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STS.003 The Rise of Modern Science

Fall 2010

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