xChapter 14

New Directions in Thought and Culture in the 16th and 17th Centuries

I. The Scientific Revolution.

i. The process that established the new view of the universe/ this is because the philosophers began reexamining and rethinking theories and data from the ancient world. / This scientific Revolution was not rapid with some brilliant ideas and some wrong ideas.

B. Nicolaus Copernicus Rejects an Earth-Centered Universe

i. Nicolaus Copernicus – (1473-1543) a Polish priest and an astronomer

ii. In 1543 Copernicus published *On the Revolutions of the Heavenly Spheres* (described as a revolution-making rather than a revolutionary text)

1. This criticized the view of the position of the earth in the universe and helped to reform the calendar based on a more accurate understanding of astronomy.

iii. The Ptolemaic System

1. Almagest was the work of Ptolemy that showed his mathematical astronomy of the place of the earth in the heavens

2. Ptolemaic systems – where the earth is the center of the universe and everything else is in spheres around it/ Then Copernicus came along and said no the sun is the center of the universe and everything revolves around the sun (he could get away with it because he was just helping the RCC better “calculate the date of Easter.”

3. Geocentrism – writers that assumed the earth was the center of the universe

4. Dante’s *Divine Comedy* said the earth was the center because of its heaviness then there was the sun and moon and other planets which they thought were fluid filled and then the realm of God was beyond that

5. There were many problems but one of them was the motion of planets because sometimes it was thought that they were going backwards

6. Epicycle – was when the planet moved uniformly about a small circle

7. Deferent – when the center of the epicycle moved uniformly about a larger circle with the earth at or near the center

8. It was pretty accurate but not completely so the Ptolemaic systems were cluttered. They were only correct if they believed the Aristotelian physics were correct.

iv. Copernicus's Universe

1. He challenged the Ptolemaic picture and adopted some of the principles but he made an heliocentric model (sun-centered).

2. This model wasn't more accurate however there were some advantages over the old model

   a. Epicycles were smaller

   b. Retrograde motion of the planets was explained because of an optical illusion that arose because people were observing them from earth …and earth was moving

3. Then he assumed that the further from the sun the longer it took to orbit the sun. Thus they grouped the planets in how far away they were from the sun.

4. Even though his model was not even more accurate it led others to start thinking of new ways the planets and sun were set up.

5. Few actually excepted the Copernican system

C. Tyco Brahe and Johannes Kepler Make New Scientific Observations

i. Tycho Brahe – 1546 – 1601 – Danish astronomer took the two major steps toward the concept of the sun-centered system

ii. Brahe did not take on Copernicus's idea and wanted to look for himself and he thought the sun and moon and some planets revolved around earth and Mercury and Venus revolved around the sun.

iii. Then he died and Johannes Kepler took over

1. 1571- 1630 he was a German astronomer

2. Deeply influenced by Renaissance Neo-Platonism/ he most definitely agreed with Copernicus.

3. He got rid of the epicycles and he portrayed motion(path of the planets) and those orbits were elliptical not circular

4. 1609 he published his work in the book *The New Astronomy*

5. He used Copernicus's sun-centered universe and Brahe's empirical data to solve the problem of planetary motion.

6. There was one problem and that was not any of the theories could explain why the planetary orbits were elliptical and why was it even an orbital at all

D. Galileo Galilei Argues for a Universe of Mathematical laws

i. 1609 Galileo Galilei (1564-1642) an Italian mathematician first turned to the heavens with a telescope.

ii. He saw stars and was the first to ever see them or know they were in existence/mountains on the moon/spots moving across the sun/ and moons orbiting Jupiter

iii. He found the heavens to be a lot more complex then everyone thought

iv. In the *Starry Messenger (1610)* and *Letters on Sunspots (1613)* Galileo argues his new found evidence requires a Copernican interpretation of the heavens.

v. It was more than just presenting arguments and evidence.

vi. He named the moons of Jupiter after the Medicis

vii. Galileo's problems with the RCC arose from both his ideas and his flair for self-advertisement.

viii. He argued that nature displayed mathematical regularity in most every detail.

E. Isaac Newton Discovers the Laws of Gravitation

i. He dealt with the issue of planetary motion

ii. Isaac Newton (1642-1727) – established a basis for physics that lasted more than two centuries

iii. 1687 Newton published *The Mathematical Principles of Natural Philosophy (Principia Mathematica) r*

iv. He believed inertia applied to bodies both at rest and in motion, so he assumed the physical objects in the universe moved by gravity

v. This explained why they moved in an orbital(gravity)

vi. Like Bacon Newton believed (empiricism) – that one must observed phenomenon before attempting to explain them.

vii. Was an opponent of the French Philosopher Rene Descartes

viii. Even though this idea of Isaac Newton was becoming accepted so was Baconian empiricism.

II. Philosophy Responds to Changing Science

A. Nature as Mechanism

i. Mechanism – a world in terms of mechanical metaphors or the language of machinery.

ii. There was a high emphasis on mathematics because it proved things

iii. Mechanism was a new way to look at the world and some thought of it was the world being the machine that God operated.

iv. Johannes Kepler wrote, “I am much occupied with the investigation of the physical causes. My aim in this is to show that the machine of the universe is not similar to a divine animated being, but similar to a clock”

v. Many people associated with the new science also believed such knowledge would strengthen the power of their monarchs.

B. Francis Bacon: The Empirical Method

i. France Bacon -1561-1626 – an Englishman

1. Regarded as the father of **empiricism** and of experimentation in science

2. Empiricism – the use of experiment and observation derived from sensory evidence to construct scientific theory or philosophy of knowledge.

3. In his books, *The Advancement of Learning (1605), the Novum Organum (1620), and The New Atlantis (1627).* He attacked the beliefs that most truth had been discovered and only needed

requirements. He encouraged people to stop trusting the ancient knowledge and search for new understandings.

4. First one to instruct change and he believed that human knowledge should produce deeds rather than words

5. He believed that expanding natural knowledge had a practical purpose and its goal was human improvement.

6. The pursuit of new knowledge would also increase the power of governments and monarchies

C. Rene Descartes: The Method of Rational Deduction

i. Rene Descartes (1596 – 1650) mathematician who invented analytic geometry

1. His most important contribution was the general principle to arrive at specific facts rather than empirical observation and induction.

2. 1637 – he published *Discourse on Method* he rejected scholastic philosophy and education and advocated mathematical model

3. He said he would doubt everything unless he could have clear and distinct ideas

4. He divided existing things into two categories

   a. Thinking things

   b. Things occupying space – mind and body, respectively

5. 1641 – *Meditations*

6. Scientific induction – scientists draw generalizations derived form and test hypotheses against empirical observations.

D. Thomas Hobbes: Apologist for Absolute Government

i. Thomas Hobbes (1588-1679) most original political philosopher of the 17th century.

ii. He took special interest in William Harvey

1. William Harvey (1578-1657) – discovery of circulation of blood through the body

iii. Hobbes first work *History of the Peloponnesian War*

iv. 1651 *Leviathan* – tried to provide rigorous philosophical justification for a strong central political authority.

v. Intended to increase pleasure and minimize pain

vi. Hobbes believed that human being sin their natural state are inclined to a “perpetual and restless desire” for power

vii. We are self – centered people who lack a master

viii. Do not that to another which you would not have done to yourself

ix. Hobbes thought rulers should be absolute and have unlimited power once established as the authority

E. John Locke: Defender of Moderate Liberty and Toleration

i. John Locke (1632-1704) – was the most influential philosophical and political thinker of the 17th century

ii. He became deeply involved with he tumultuous politics of the English Restoration period

iii. He was a close associate of Anthony Ashley Cooper (the earl of Shaftesbury) (1621-1683) – considered by his contemporaries to be a radical in both religion and politics

iv. He led an unsuccessful rebellion against Charles II in 1682 and then had to flee from Holland.

v. Locke wrote 2 treatises on government

1. First Treatise of Government

    a. He rejected arguments for absolute government that based political authority on the patriarchal model of fathers ruling over a family

    b. This cleared the philosophical decks

2. Second Treatise of Government

    a. He presented an extended argument for a government that must necessarily be both responsible for and responsive to the concerns of the governed. Natural state of human beings, Locke believed, was goodwill. /government is one of little authority.

b. If rulers betrayed trust the governed have a right to replace them

c. 1689 *Letter Concerning Toleration*

i. Were required to work out his or her own religious salvation

d. Locke hoped to explain the basic structures of human though

i. Essay Concerning Human Understanding (1690)

1. Major work of European psychology during the 18th century

e. For Locke, reason and revelation were compatible and together could sustain a moderate religious faith that would avoid religious conflict.

III. The New Institutions of expanding Natural Knowledge

A. Ne knowledge about nature and humankind could be discovered. The people just needed to look.

B. Some scholars tried to preserve the traditional outlooks and they were basically defending the ancients against the moderns

C. Most of the Philosophers attended a University and the Universities provided physical and financial support for teaching and investigating natural philosophy and employed many scientist.

D. Royal Society of London …founded in 1660 – where the new science was gathered, exchanged, and debated (the members saw themselves as following the path Bacon had laid out almost half a century earlier.

E. There also was Academy of Experiments in Florence in 1657

F. French Academy of Science in 1666

G. Berlin Academy of Science was founded in 1700

H. Experiments were being made in many local societies and academies

I. Projectors – people who had ideas for improving production, navigation, or military artillery might seek the support of the associated societies.

J. Enlightenment – the 18th century movement led by the Philosophes that held that change and reform were both desirable through the application of reason and science.

IV. Women in the World of the Scientific Revolution

A. Women were excluded from European universities until the end of the 19th century

B. Queen Christina of Sweden (1632-1654) was an exception and did determine those patronage decisions or benefits from them

C. It was not easy for women to pursue science because they were not admitted to membership anywhere.

D. Noblewomen and woman from the artisan class were some women that managed to engage in the new scientific activity.

E. Margaret Cavendish (1623-1673) made a significant contribution to the scientific literature of the day. / she was privately tutored/ she married duke of Newcastle which introduced her into a circle of natural philosophers

i. Her most important works were, *Observations Upon Experimental Philosophy (1666) and Grounds of Natural Philosophy (1668)*

ii. Only woman in the 17th century to be allowed to visit a meeting of the Royal Society of London

iii. Maria Cunitz (female astronomer) she wrote a book about astronomy that many people thought her husband wrote it until he swore she did

iv. Maria Winkelmann discovered a comet in 1702/ she died in 1720

v. Margaret Cavendish compose a *Description of a New World, Called the Blazing World (1666)* –this introduced women to the new science

vi. During the 1730's Emilie du Chatelet (1706-1749) – she aided Voltaire in his composition of an important French popularization of Newton's science/ great mind of mathematics. / she translated *Principia* into French

vii. The pursuit of knowledge about nature was a male vocation

V. The New Science and Religious Faith

A. The new science posed three major issues

i. Certain theories and discoveries did not agree with biblical statements about the heavens

ii. Who would decide conflicts between religion and science-church authorities or the natural philosophers?

iii. For many religious thinkers the new science seemed to replace a universe of spiritual meaning and significance with a purely materialistic one

B. The Case of Galileo

i. Most famous incident of conflict between modern science and religious institutions was the condemnation of Galileo by RCC in 1633

ii. Council of Trent (1545-1563) said only the church had authority to interpret the Bible.

iii. *Letter to the Grand Duchess Christina (1615)* Galileo's vies about how scripture should be interpreted to accommodate the new science

iv. *On the Revolutions of the Heavenly Spheres* by Copernicus this was put in the Index of Prohibited Books.

v. There still was not enough evidence to support Copernicus's idea yet

vi. In 1623 a friend of Galileo's was elected as Pope Urban VIII. And this pope gave Galileo permission to resume discussing the Copernican system

vii. Galileo did so in *Dialogue on the Two Chief World Systems (1632)* – it was used to designed to defend the physical truthfulness of Copernicanism

viii. The pope then ordered an investigation on Galileo's book and the issue in Galileo's trial of 1633 was whether he had disobeyed the mandate of 1616

ix. He was condemned and put under house arrest in Florence

x. Scientific theory and religious piety are compatible

C. Blaise Pascal: Reason and Faith

i. Blaise Pascal (1623-1662) a French mathematician and a physical scientist/ he made one of the most influential efforts to reconcile faith and the new science

1. He wrote a work that would disprove dogmatism and skepticism
2. He saw two essential truths in the Christian religion
    a. A loving God exists
    b. Human beings, because they are corrupt by nature, are utterly unworthy of God.
3. If there is a God the believer will gain everything whereas should God prove not to exist they won't lose anything

ii. Limitations of science and reason

iii. Reason will never explain the existence of God

iv. Belief in God results in the improvement in one's life

D. The English Approach to Science and Religion

i. Francis Bacon argued there were two books of divine revelation

1. Bible
2. Nature – deeper knowledge of things divine

ii. Later in the 17th century, Newton's work showed that the natural universe became a realm of law and regularity

iii. They realized that the creator of this rational, lawful nature must also be rational

iv. Science and religious faith were compatible and mutually supportive

v. Physico-theology – religious thought associated with such deducing of religious conclusion from nature

vi. Faith in a natural God encouraged faith in the rationality of human beings.

vii. John Ray – *The Wisdom of God Manifested in His Works of Creation*

viii. Human beings were meant to improve the world

E. Is Science The Measuring Stick of All Knowledge

VI. Continuing Superstition

A. By the end of the 17th century almost all Europeans believed in the power of demons

B. Witch-Hunts and Panic

i. Between 1400-1700, courts sentenced an estimated 70,000-100,000 people to death for harmful magic and witchcraft.

ii. Sabots- mass meetings to which they were believed to fly.

iii. Witches were believed to indulge in sexual orgies with the evil, who appeared in goat form.

C. Village Origins

i. Cunning folk – helped people cope with natural disasters and disabilities by magical means

ii. People believed it helped the whole village to move on in times of calamity

D. Influence of the Clergy

i. Christian clergy practiced high magic – they could transform bread and wine into the body and blood of Christ. / eternal penalties for sin into temporal ones/ and also claimed to have the power to cast out demons

ii. The church said that the only true magic came from God or the devil and if the churched practiced "magic" it was God.

E. Who Were the Witches?

i. 80% of victims of witch hunts were women/ most single or over forty/

ii. Mainly out of male hatred

iii. Three women groups that have drawn the witch-hunter's attention

1. Widows – living alone after death of husbands
2. Midwives- work made them unpopular when the kids died
3. Woman healers and Herbalists – their work gave them a moral and spiritual authority over people that the church wished to reserve for its priest.

F. End of the Witch-Hunts

i. Mind and matter were two independent realities

ii. The witch's curses were now mere words

iii. The witch-hunts began to get out of hand

VII. Baroque Art

A. Baroque – to denote the style associated with 17th century painting, sculpture, and architecture. / it covers a variety of related styles that developed during the century and moved in different directions in different countries.

B. Baroque artists – depicted their subjects in naturalistic ways rather then idealized manner.

C. Michelangelo Caravagio (1573-1610) – devoted to picturing sharp contrast between light and darkness, which created dramatic scenes in their painting

D. Baroque artists served both religious and secular ends

E. Louis LeNain (1593 -1648) – painted scenes of French peasant life