

Origins of Scientific Thought

- **Milestones in the Development of Modern Understanding**

Let's trace the explanations of where we came from

- **from stone age man, to nomadic tribes, to development of agriculture and domestication of animals, to villages, to cities and city states, through the rise of empires, theocracies, civilizations, to nations, up to the present**

• Progression: Myth to Religion to Science

- Primitive tribes worshiped multiple deities**
- Egyptians had gods that were half human**
- Greeks had gods in human form**
- The Jews replaced those gods with one abstract god**
- Many of these ideas have gradually been replaced by scientific explanations**

•Gods Used as Explanations

- deities used to fill voids in our understanding**
- as man's understanding increases, man's ideas of God change**

•10,000 B.C. Gods of Nature

- first cave drawings, nomadic tribes**
- gods of the hunt, gods of war, goddesses of fertility**
- examples: American Indians,**

Gods of Early Civilizations

- **Examples: Incas, Aztecs, Mayans**
- **believed the sun was in a daily battle against the night**
- **to win these battles, the gods required nourishment of human hearts and blood**
- **so thousands of humans per year were sacrificed to the bloodthirsty gods**
- **their hearts were cut out while still beating**

Bloodthirsty Gods

- one of the most impressive sights in the world is the enormous Pyramid of the Sun, 20 stories high
- built in 700 in Teotihuacan, which means the Place of the Gods
- in 1490, the Aztecs consecrated a temple in their capital Tenochtitlan, near Mexcio City, to their principal god Huitzilopochtli
 - 20,000 victims were sacrificed
 - grisly ceremony took four days

- **2000 B.C. Egyptian gods**

- **half human, half animal**
- **Pharaoh is a god**
- **powerful enough beliefs to build pyramids**
- **Book of the Dead**
 - **similar to Jewish Bible**

•1000 B.C. Greek and Roman mythology

- immortal gods in human form**
- heaven and earth mated and formed the gods**
- play chess with the lives of men**
- gods not omnipotent or omniscient**
 - could be opposed and deceived**
 - gods were easy to keep happy**
 - men are free to laugh at the gods**
 - no fearsome spirits, unknowns or incomprehensibilities like those worshipped elsewhere**

Greek Gods

- **Zeus, King of the Gods, Lord of the Sky**
 - endlessly having love affairs with mortal women
 - tricks to hide his infidelity from his wife
- **Neptune, god of the sea**
- **Hades, ruled over the underworld and the dead**
- **Venus, Goddess of love and beauty**
 - Pandora's box, Pegasus
 - Achilles heel, Trojan war
 - Prometheus
 - The Illiad, the Odessy

Seven Wonders of the Ancient World

- **Pyramid of Egypt**
 - labor of 100,000 men for 20 years
- **Temple of Diana at Ephesus**
 - 400 feet long, 60 feet high, took 120 years to build
 - Diana was the sister of Helios, the sun god
- **Statue of Zeus at Olympia**
 - 40 feet high, of gold, ivory and precious stones
 - for the Olympic games, 400 B.C.

Seven Wonders of the Ancient World

- **Colossus of Rhodes**
 - **statute of the sun god Helios, 100 ft. tall, 200 B.C.**
- **Pharos Lighthouse**
- **Mausoleum at Halicarnassus**
- **Hanging Gardens of Babylon**

Of the Seven Wonders of the Ancient World, Four are tributes to their Gods

- The massive toil required to build these monuments vividly demonstrate the reverence the people had for their deities.**
- The reverence the ancients had for their gods must equal the reverence men have for their modern ideas of god.**
- This vividly demonstrates that**

Ideas of god change over time

- We dismiss with laughter what they took very seriously.**
- One must keep an open mind over the long run of history.**
- Future civilizations may laugh at the ideas of god that are popular today.**

•The Parthenon on the Acropolis

- Temple in honor of Athena, patron goddess of Athens**
- inside was a great gold and ivory statue of the goddess**
- built in 5th century B.C.**
- called the most famous monument in the entire history of mankind**

Oracle at Delphi

- site was sacred to the god Apollo
- a young virgin girl would utter weird sounds while in a frenzy
- it was believed she was repeating words inspired by the god
- temple priests would then interpret the message to the public
- the Christian Roman Emperor Theodosius I destroyed the sanctuary in A.D. 390

~0 A.D. Jewish god and Christianity

- **unifies all gods into one**
- **all powerful,**
- **all present god**
- **abstract form.**

• **Religion: Our Best Ideas**

~2000 Years Ago

- **based on the best understanding of the world at the time:**
- **Earth was flat, at center of universe**
- **stars hung from the firmament, 7 spheres moved by angels**
- **everything made from the 4 elements**
 - **air, earth, fire and water**
- **all living things were created**
 - **Eve out of Adam's rib**

Religion: Based on Ancient Concepts

- **previous to understanding:**
- **the earth is round**
- **vast age of the earth**
- **circulation of the blood**

Religion: Based on Ancient Concepts

- **previous to understanding:**
- **cellular basis of life**
- **bacteria caused disease**
- **evolution by natural selection**

Their Picture of the Universe

- the earth was at the center**
- everything moved around the earth in fixed spheres**
- the angelic and celestial regions lay beyond**
- it presented a unified view of the physical and the spiritual worlds**
- the ascent from earth to heaven was both physical and spiritual**

The Firmament

- from 148th Psalm “the waters which are above the firmament”
- believed to be the solid outer shell of the universe
- heaven was outside the shell

Heaven is up, Hell is down

- **Christ descended into hell then rose into heaven**
- **Mary ascended into heaven**

Concept of Heaven shown in Biblical Tower of Babel

- **Men attempted to build a tower that would reach heaven.**
- **God apparently felt threatened so he prevented the attempt by confusing the men with different languages.**

330 A.D. Constantine

- **legalized Christianity**
- **baptized on his deathbed**
 - **His thinking was: since baptism washed away all sins and could not be repeated,**
 - **it was bad economy to hurry it**
- **church and state began to merge**
 - **sign of the cross appeared on Roman coins**
- **Christianity was the official religion**

385 A.D. the Church was itself beginning to execute heretics

- The last great wave of persecutions occurred in 303 A.D. under Emperor Diocletian.**
- It is ironic that in only 80 years the Christians had changed from being persecuted into doing their own persecutions.**

389 A.D. Bishop Theophilus destroys the Serapeum in Alexandria

- **the most important pagan library
in the world**

426 A.D. Theodosius II

Campaigns against Paganism

- **destroys Grecian temples at Olympia, home of the Olympic games**
- **closes the Oracle at Delphi**

476 A.D. the Fall of Rome

800 A.D. Charlemagne crowned Holy Roman Emperor

- He imposed baptism by the sword.**
- He decreed any who reject baptism should be put to death.**
- He continued the forced Christianization of Europe which took centuries and cost million of lives.**
- The Holy Roman Empire and the unity of Christendom was more of an ideal than a reality.**
- By early 16th century the concept of one political power and one spiritual power was being destroyed in Europe.**

•The Church dominates society

- reason and criticism had been condemned**
- displaced by Christian faith**
- theology was all pervading and all controlling**
- persisted until the Renaissance**
- known as the Age of Faith**
- also termed The Dark Ages**

The Dark Ages 4th to 14th Century

- **no separation of church and state, a theocracy**
- **to question any aspect of the church's teachings was heresy**
- **heresy was an offense against the state**
- **heretics and pagans subject to flogging, exile, death**

The Inquisition: Six Centuries of Holy Terror

- **bishops and friars were to “inquire” into errors of the people**
- **1252 Pope Innocent IV officially sanctions torture to extract confession**
- **Dominican and Franciscan inquisitors were formidable figures**
- **could excommunicate even princes**
 - **anyone excommunicated lost political and legal rights as well**
- **result was an appalling slaughter in the name of religion**

Inquisition: a Religious Police State

- **instrument of repression**
- **used against Protestants, Jews, Muslims, witches, scientists**
- **widespread throughout all of Christendom**
- **not abolished in the Catholic Church until 1816**
- **suppressed in Spain in 1834**

A Modern Analogy:

- **You, the listener, would be publicly flogged.**
- **I, the author of this paper, would be burned at the stake.**
- **This TV show would be put on the List of Forbidden Books.**

the Church: Powerful, Wealthy and Corrupt

- **untaxed land = perhaps a third of Europe**
- **vast wealth came from:**
- **donations for religious services**
- **paid indulgences, financial means to salvation**
- **simony, the purchase of a church office**

Rival Popes

- **At times there were two, sometimes three popes at the same time, each claiming to be genuine while calling the others false**
 - **called the anti-popes**
 - **happened 34 times in the history of the Church**
 - **at times, the countries of Europe were divided as to which pope they followed**
 - **encouraged contempt for the office**

The Church: preoccupation with art

- **Vatican was opulent beyond imagination**
 - » while the cities did not have sewer systems
- **the poor exchanged their savings for salvation**
- **the money was used for the glorification of the church**
- **rich church, poor people**

Life: A Perilous Journey for the Soul

- from Anne Fremantle, *Age of Faith*, Time Life Books, p61
- **The chief importance of his mundane life was that its course would decide the fate of his immortal soul.**
- **Each day, as he struggled between good and evil, his soul in its journey drew ever closer to heaven - or to hell.**

A World under Siege by Devils and Demons

- **Jonathan Weier in 1568 counted the demons and put their number at 7,405,926, comprising 1111 legions of 6666 each, "apart" as he says, "from the errors of calculation."**
- **Demons would cause storms, could produce wind, rain, hail and drought,**
- **or make a priest sneeze in the middle of his finest passage, or cause him to forget his words**

- **The devil was so treacherous according to one distinguished preacher, that even the saintly were suspect: he appeared in the guise of “apostles and angels and other saints and good men.”**
- **To many saintly monks, the devil appeared as a charming young woman who would tempt them into carnal sin, then suddenly transform herself into the hideous devil that she was.**

**Christian teachings
persuaded medieval man
that the spiritual world was
fully as real as the physical
world**

- **believed devils, demons, spirits
were real and influenced their lives**

13th Century: Roger Bacon

- **One of the first experimental scientists**
- **discovered gunpowder**
- **also into alchemy and astrology**
- **believed experiment and observation as a means of knowing the world were more valuable than divine reasoning**
- **Pope Nicholas IV forbade his books**
- **arrested then 10 years in prison**

13th Century: Dante

- **Divine Comedy, also known as the Inferno**
- **depicted a journey through hell**
 - **nine circles of hell, inside earth**
 - **the hole was formed by Lucifer falling from Heaven**
 - **direct inversion of heavenly spheres of planets**
 - **described the landscape of hell in great detail**
 - **Galileo did a playful student thesis analyzing the dimensions of Dante's hell**

Reaction to Dante

- **advocated pope and kings should have separate powers**
- **banished threatened with death at the stake**

Vivid descriptions and pictures of hell were plentiful

- **Heaven, and its antithesis, hell, were a deep and pervasive part of their thinking**
- **occupied a great deal of their attention**

Two Alternatives: with god or burning in fiery stench

- **with Christ or damned to hell**
- **the saints in heaven could watch
the punishment of sinners in hell**
 - **emphasized by Thomas Aquinas,
~1250, called the abominable fancy**

Purgatory: new doctrine

Papal letter of 1253

- **to be allowed to enter heaven, you did not have to be totally pure**
- **you could be purged of lesser sins**
- **purgatory offered a new chance to get to heaven**
- **Powerful Propaganda**
- **also explained ghosts**

Indulgences: Spiritual Forgiveness for Sale

- Prayers of the living could shorten the time the dead had to spend in purgatory.**
- The mere sight of the true cross earned the pilgrim 12,000 years indulgence.**
- Divine wrath might be averted by gifts of land, money or privileges to churches, monasteries and shrines.**
- The Church went into the business of selling pardons or indulgences for the remission of punishment after death.**

Indulgences, Spiritual Forgiveness for Sale

- **The Church even began to offer forgiveness for sins not yet committed.**
 - **buy now and sin later**
 - **in effect buying a license to sin, with an assurance that the sin not yet committed was already pardoned**

Indulgences

- **The only sin one could not purchase forgiveness for was heresy -**
 - **that would destroy the goose that laid the golden eggs**
 - **in other words, to allow critics to challenge the church would take away the Churches position of spiritual monopoly and mediator to god**

1400: The Black Death

- Its descriptions are ghastly, heaps of unburied dead, people in panic, death everywhere.**
- Estimates of the toll range from one fourth to a third of the entire population of Europe.**
- There was widespread conviction that the plague represented divine retribution for human sins.**
- The priests cried that vices had brought God's anger and that terrible judgement upon the whole nation. They called for repentance, fasting, humiliation and public confession.**

1400: The Black Death

- **The Christians fell upon their knees, made confession of their sins, looked up at their merciful Savior for pardon, imploring his compassion on them in their time of need.**
- **Fright and horror sent the faithful into frenzies of religious extremes - self-flagellants scourged themselves to purge themselves of sin.**
- **The religious authorities forbid plays, gaming tables, public dance rooms, music houses and puppet shows.**

1400: The Black Death

- **Others turned to superstition and mysticism of all kinds, charlatans selling anti-pestilence pills, conjurers and pretenders to magic selling charms and amulets and secrets to prevent infection.**
- **All to no avail, the plague took rich and poor alike.**
- **In Naples, 20,000 died in one day.**

The Black Death: An Epilogue

- **It wasn't until 1907 that the British gov't proved the disease was carried by fleas on rats.**
- **In retrospect we can see:**
 - **religious processions through the towns actually helped spread the disease**
 - **the pneumonic plague was very contagious, the infected, by their very breath poisoned those with whom they spoke.**
 - **less energy and attention to spiritual matters and more to sanitation would have helped tremendously.**

the Great Schism: breakup of the Medieval Church

- **1517: Martin Luther nails his 95 theses on the door of the Cathedral in Wittenburg.**
- **He said church interference in afterlife was false.**
 - **It was concocted by bad men for greed.**
- **He threw out Purgatory.**
- **He said prayers for the dead were useless.**

Luther, continued

- **a year later he was summoned by the Inquisition to Rome**
- **appealed to the people and the German princes against the Church**
- **gambled his life against his principles**
- **formed his own church**

Luther: as superstitious as the Catholics

- Luther supported superstition even more zealously than the Catholics.**
- He sometimes asserted his belief that the winds themselves are only good or evil spirits.**

Lutheranism: witch hunts worse than the Catholics

- An incubus would mate with a man, and get his seed.**
- Then transform into a succubus and mate with a woman.**
- The result would be a child of the devil.**
- Luther recommended a mother throw her devil begotten child into the river in order to free their house from the presence of evil.**

1533 King Henry VIII breaks with Rome

- **in order to get a divorce, he broke with the Church**
 - **Henry had a total of 6 wives, and had 3 of them executed**
- **formed the Church of England, and established the king as its supreme head**
 - **beheaded bishops who indicated uneasiness about the unity of church and state**
 - **formed the papacy without the pope**

Luther, Calvin, King Henry: The dam breaks

- **The Churches monopoly on divine righteousness is shattered**

80 Varieties of Protestantism Appeared within a Century

- **Having abandoned traditional authority, Protestants based all their arguments on scriptures.**
- **Each used the same source of information - the Bible.**

80 Varieties of Protestantism

- **Each was prepared to defend itself by fire and sword against other groups that interpreted the Bible differently.**
 - [This illustrates that the Bible is ambiguous and an insufficient source of guidance.]
 - **as one example:**
 - **In France, a period of atrocity between the Protestants and Catholics lasted 36 years.**
 - **Ten thousand Protestants lost their lives in one day in 1572, called the St. Bartholomew's Day Massacre.**

For the masses, one religion was as good as the other

- As long as it offered personal advantage and reasonable safety and assurances of its priests that it conveyed salvation.**
- The following centuries are marked with religious wars by the competing Christian sects.**

- **1519 Magellan proves the world is round**
- **didn't sail off the edge of the world**
- **caused a major paradigm shift**

“At last they found that the earth is round. It was circumnavigated by Magellan. In 1519, that brave man set sail. The church told him: “The earth is flat, my friend, don’t go, you may fall off the edge.” Magellan said: “I have seen the shadow of the earth upon the moon, and I have more confidence in the shadow than I have in the church.” The ship went round. The earth was circumnavigated. Science passed its hand above and beneath it, and where was the old heaven and where was the hell? Vanished forever!” Robert Ingersoll

1543 Vesalius: first Anatomist

- Up till then ancient teachings were accepted as dogma, unquestioned.**
- Dissections of human body were forbidden to Christians.**
- He applied scientific observation to the human body.**
- He braved the tortures of the Inquisition to explore the worlds inside us.**
- At 28, he published his great work -**
 - a triumph of anatomy and a masterpiece of art.**

1543 Vesalius, continued

- **He became the personal physician of Emperor Charles IV.**
- **When his political protection ended, he continued to be bitterly attacked.**
- **He was forced to take a pilgrimage to the Holy Land to atone for his sins, during which he was shipwrecked and died.**
- **Vesalius is a landmark in the breakaway of theological theory from medicine.**

1543 Copernicus

- **suggested sun centered solar system**
 - **dared not discuss the matter in Rome, returned to Poland**
- **did not have it published until after he died**
- **published not as truth but as fanciful hypothesis**

1559 Vatican publishes

'Index Librorum

Prohibitorum'

the List of Forbidden Books

- **dangerous to faith and morals**
- **penalty for possession or reading was excommunication**
- **continued for 4 centuries**
 - [The Catholic Church published the List of Forbidden Books up until 1948.
 - **Published by the Congregation of the Holy Office, the same tribunal within the Catholic Church which was responsible for the Inquisition]**

- **1600 Galileo: the father of modern experimental science**

- **previously, the divinely appointed way to arrive at truth**

- **was by theological reasoning on the text of scriptures**

- **or on teachings of ancient wise men**

- **[by belief in ancient teachings]**

- **demonstrated falling objects from the Leaning Tower of Pisa**

- **proved Aristotle's teachings of gravity to be false**

Galileo: the Earth is not the center of the universe

- **agreed with Copernicus (1543)**
- **built the first telescope and saw moons orbiting around Jupiter**
- **put a big dent in the concept of the earth being the center of the universe with all the planetary bodies rotating around it**
- **his writings caused a scandal**

•The Helio-Centric Controversy

- to say the earth moved around the sun defied the Biblical story that Josua stopped the sun in the sky**
- really means that Josua stopped the earth from rotating**
 - rotating 1000 miles per hour - a very sudden deceleration**
- indicated the Bible and beliefs held for 1600 years were wrong**

•Reaction to Galileo

- summoned to trial in Rome by the Inquisition**
- sentenced to life imprisonment for heresy**
- his books were ordered burned**
- he was exiled from his family and friends**
- kept under close surveillance**
- he was 70 years old at this time**

Church forces Galileo to recant his beliefs

- In 1632, the Church and the its inquisitors forced Galileo to pronounce publicly his recantation: “ I Galileo, being in my seventieth year, being a prisoner and on my knees, having before my eyes the Holy Gospel, which I touch with my hands, abjure, curse, and detest the error and the heresy of the movement of the earth.”**

- **he was forced to report any other man of science who supported “the heresy of motion of the earth” to the Inquisition**
- **all writings which affirm the motion of the earth were place on the Index**
- **His ideas were suppressed for a hundred years.**

Galileo: Epilogue

- from *A History of the Warfare of Science with Theology in Christendom*, by Andrew White
- His request to be buried in his family tomb was denied
- He was buried ignobly, apart from his family, without any ceremony, monument or epitaph
- Not until 40 years later did Pierrrozzi dare to write an inscription above his bones

Galileo: Epilogue

- from Andrew White, con't
- **Not until a hundred years later did Nelli dare transfer his remains to a suitable position, and erect a monument above them**
- **Even then, the Inquisition sought to prevent such honors 'to a man condemned for notorious errors', and that tribunal refused to allow any epitaph to be placed above him which had not been submitted to its censorship.**

Galileo: Epilogue

- **Pope Urban VIII issued a Bull, which coming from the highest authority of the Church, is characterized by infallibility under divine guarantee, as the pope is the divinely guided teacher in matters of faith and morals.**
- **From 1633 to 1835, by the infallible dictate of the Pope, the earth stood still.**

Galileo: Epilogue

- **A symbol of a lifelong struggle to free scientific inquiry**
 - from theological interference
- **In 1984, the Papal commission acknowledged Church was wrong.**
- **In 1992, the Church reversed its condemnation of Galileo.**
 - Exonerated by Pope Paul II, three and a half centuries later

- **1628 Harvey discovers circulation of the blood**
- **Previous belief:**
 - **blood originated in the liver**
 - **boiled in the heart**
 - **went out the through the blood vessels**
 - **into the ether**
- **proposed a closed circulatory system**
 - **didn't know capillary system connected arteries to veins**

Reaction to Harvey

- **refused to accept for a hundred years**
- **diseases were caused by imbalances of the four bodily humors**
 - **blood, phlegm, yellow bile and black bile**
- **Bloodletting continued to balance the spirits.**
 - **the red-striped pole symbol of the barber-surgeon**
 - **the red stripe signified the blood of the patients**

Descartes (1596 - 1650)

- **wanted to prove the certainty of existence.**
- **“Cogito ergo sum”, I think therefore I am.**
- **Our consciousness proves our existence.**
- **As soon as you try to doubt your existence you see that you must exist as the doubter. You cannot doubt that you are doubting.**

Descartes argued against miraculous exceptions

- insisted on the immutability of nature**
- damned as a 'mechanist', or as one who regarded the universe not as the plaything of a higher power but as something to be interpreted solely in terms of law and order**

1609 Kepler: laws of planetary motion

- **He inherited the data collected over a lifetime by Tycho Brahe**
- **Kepler worked for years analyzing the data.**
 - **[They didn't have calculators in those days]**
- **The positions of the data did not fit spherical orbits.**
 - **they were off by an angle equivalent of a head of a pin at arm's length**

Kepler, con't

- He re-analyzed the data and found it fit elliptical orbits.
- His laws bound the heavenly bodies to predictable pathways
- Angels were no longer needed to account for the motion of the planets

1656 Archbishop Usher: the earth is 6000 years old

- **Heaven and earth were created on Sunday, October 23, 4004 B.C.**
 - **the following Tuesday, dry land appeared**
 - **Friday, man and other forms of life appeared**

1656 Archbishop Usher: the earth is 6000 years old

- **concluded by adding ages of all the figures in the Bible**
- **recorded genealogies of ancient Chinese families extend before the time of creation itself**
- **how could Africa and South America drift apart in 6000 years?**
- **plate tectonics shows the ancient Gondwana continent broke into Africa and South America 100 million years ago**

- **1674 Leeuwenhoek invents the first Microscope**

- **discovers microorganisms**
- **he “saw many thousands of creatures in one small drop of water”**
- **sperm**
- **red blood cells**

Hooke (1635- 1703) uses compound microscope

- **shows all living things are made up
of tiny cells**

The Nature of the Heavens: A Controversy that raged for Centuries

- **prior to Galileo and Newton, theologians ascribed celestial activities as direct manifestation of God's work**
- **angels moved the planets and the stars**

1687 Newton shows how the universe is held together

- **he compressed a huge amount of info about the universe into one concise law**
- **powerful and pervasive**
- **no need to impose the creator to cause movements of the heavenly bodies**
 - **movements happen all by themselves**

An upheaval in our Understanding of the Heavens

- **Laws of Nature replace planetary movements by Angels**

**Kepler, Galileo and
Newton destroyed the
view of the heavens held
by religion for 2000 years**

Newton ushered in the Scientific Epoch

- **the Newton era created celestial mechanics and laws of motion**
 - **but destroyed heaven, the seat of God, and the eventual dwelling of privileged human souls. God lost not only his home, but his importance.**
- **also invented calculus**
- **one of the greatest names in the history of human thought**

1692 Salem Witchcraft

- **illness or storms attributed to witches**
- **arrested on gossip**
- **tortured until confessed**
- **judges received a stipend of dollars per head for each witch burned**
- **investigating agents were allowed to extract fees from those they summon**
- **shameful Church/State terrorism**

Origins of Witchcraft

- **Exodus 22:18** Thou shalt not suffer a witch to live.
Exodus 22:19 Whosoever lieth with a beast shall surely be put to death.
Exodus 22:20 He that sacrificeth unto [any] god, save unto the LORD only, he shall be utterly destroyed.

Powerless to stop the Witch hunts

- **Anyone attempting to defend the prisoner would be labeled a supporter of witchcraft, thus everybody, due to fear, kept quiet.**
- **At great personal risk a few protested the witch mania:**
- **“In Heaven’s name, how can anybody, no matter how innocent escape?” Fredrick Von Spree, 1631**

- **1752 Franklin shows lightning is electricity**

- **flies a kite in a thunderstorm and charges up a Lyden jar**
 - **thought of electricity as liquid**
- **employs the first lightning rod**

Storms: the Voice of God

- cathedrals everywhere, being the highest structures, were damaged frequently by lightning**
- since storms were caused by god or devils, the religious authorities responded by putting angels at the summit, ringing consecrated bells to ward off the powers of the air and religious processions throughout the city**
- at times the damage and loss of life was so great that peasants feared to attend service**
- people wondered why the almighty would strike his own consecrated temples?**

- **Lightning -**
- **divine punishment by god**
- **at first Franklin's rod was widely condemned**
 - **the 1775 earthquake in Massachusetts was widely described by hellfire and brimstone preachers as being caused by use of Franklin's rod**
 - **Rev. Thomas Prince sermoned "The frequency of earthquakes may be due to the erection of iron points invented by the sagacious Mr. Franklin."**
 - **He argued "in Boston more are erected than anywhere else in New England and Boston seems to be more dreadfully shaken. Oh! There is no getting out of the mighty hand of God!"**

Lightning Rods Gain Acceptance

- over the next 50 years, more and more began to permit lightning rods to be placed on high buildings**
- in Germany as late as 1783, 33 years after Franklin's demonstration, nearly 400 towers had been damaged and 120 bell ringers killed**

•Lightning Rods on Churches

- the success of the rods on other buildings gradually forced their use on churches to become more widespread
- The lightning rod accomplished what exorcisms, processions, the ringing of church bells, and the torture and burning of witches failed to do.
- religious authorities slowly began to acknowledge that God had nothing to do with lightning

1774 Lavoisier explains Fire

- show it to be union of the burning material with oxygen**
- proves there is as much mass after the candle burns as before**
- conclusion: matter can neither be created or destroyed**

Lavoisier explains the Fire of Life

- **combustion in the body is slow burning of food**
- **helps dispels age old beliefs in 4 elements**
 - **air, earth, fire and water**

•1778 Linnaeus Categorizes all Living Things

- formulates a tree of life**
- logical groupings based on morphological similarities**
- major milestone in understanding of life**
 - however, assumed eternal fixity of species**
 - all species remained unaltered since the 6 days of creation**

•Uniformity vs Catastrophism

- another controversy raging for centuries**
- catastrophism explained different fossil layers by postulating great upheavals like the flood**

Uniformity

- **an explanation of the world using the forces of nature, the same forces we see today**
- **natural phenomenon occurred in the past in the same way as they occur now**
- **acting throughout vast expanses of time**

Descartes insisted on Uniformity of Nature

- **requires no miracles or unknown processes**
- **laws of nature are invariable not to be changed as the playthings of the gods**

1795 Hutton explains geology, mountains, oceans and fossils

- no catastrophic events causing sudden changes in the fossil record [Noah's ark]**
- saw fossils on top of a mountain chain, which had a downward slope, went underneath another mountain**
- This indicates the earth's age could be very great**

1790 Erasmus Darwin:

- **doctrine of mutability of species**
- **all body parts contribute gemmules that go to the germ cells**
- **wrote his ideas in poetry as to not challenge the authorities**
- **major claim to fame: grandfather of Charles Darwin**

1796 Jenner: First Vaccination

- **Smallpox was an ever present horror of the 17th century.**
- **The victims of the disease were horribly scarred and pitted.**
- **The disease was considered to be punishment by God.**
- **Jenner showed vaccination to cowpox would prevent smallpox.**
- **To theological thinkers, preventing the disease was to thwart god's will.**

Reaction to Jenner, cont

- **in 1798 an Anti-vaccination Society was formed by clergymen who called on the people of Boston to suppress vaccination as, “bidding defiance to Heaven itself, even to the will of God,” and declared that “the law of God prohibits the practice.”**
- **Bitter opposition continued for years.**

Reaction to Jenner, cont

- **In 1885 a plague broke out in Montreal. Protestants accepted vaccination and escaped smallpox, the orthodox Catholics refused vaccination and were ravaged by it. The truth became very obvious. The priest of the St. James Church declared in a sermon “If we are afflicted with smallpox, it is because we had a carnival last winter, feasting the flesh, which has offended the Lord; ... it is to punish our pride that God has sent us smallpox.”**

1804 Napoleon Coronation

- invited the Pope to Paris for his coronation**
- rather than pledge obedience to the Pope**
- he seized the laurel wreath and crowned himself**
- was a striking example of the loss of the power of the pope, only a shadow of his former power**

Science approaches the Holy of Holies - the nature of reproduction and heredity

- **Up to now it was thought that life was not reducible to the laws of physics and chemistry**
- **there was a 'vital force'**
- **god breathed this 'vital force' into inanimate matter giving it life**

1774 Priestly discovers oxygen

- **Discovered animal respiration**
- **weighed a mouse before and after it dies**
- **it weighed the same**
- **his house and church were pillaged and burned by an enraged mob**
- **he moved to the U.S. in 1791**

•1809 Lamarck:

- postulated animals wants and needs give rise to new organs**
- Use and disuse cause changes which are inherited.**
- It explained the diversification of life.**
- However, experimentalists showed amputation of rats' tails has no effect on their progeny**

•Controversy over Spontaneous Generation of Life

- abiogenesis - life comes out of nothing**
- when rain hits mud, frogs are generated**
- 1665 Redi showed flies won't come from meat if protected by mesh**
- heated controversy for 200 years**

1816: Inquisitional torture is abolished in the Catholic Church

- **The last bastion of support for the reality of witchcraft and the necessity of its punishment were the Christian churches.**

1830 first Railroad

1837 The Cellular Theory of Life

- **Schleiden and Schwann**
- **all plant growth results from production of new cells**
- **[striking to realize how late we reached this understanding**
- **can see why earlier ideas seem so primitive]**

• **1852 Malthus**

- **"Principles of Population as it Affects the Future Improvements of Society"**
- **describes the math of living things reproducing themselves exponentially**
- **Rapidly reach the limits of the food supply**
- **Result: there is an intense competition to live**
- **Struggle for Existence**

• 1859 Charles Darwin: Origin of Species

- life is product of gradual change**
- over vast periods of time**
- survival of the fittest is the mechanism of evolution**
- natural selection as a filter which separates the good from the bad**
- 1871 publishes the Descent of Man**

Evolution: tiny genetic variations accumulating over vast expanses of time

- **differences between siblings in one generation**
 - a million generations
 - at 20 years per generation = 20 million years
- **our ancestors 20 million years ago could be very different than ourselves today**

•Reaction to Darwin:

- no need for God to explain the origin of life**
- His ideas are still gaining acceptance 140 years later**
- Homocentric universe again challenged**

“If I were to give an award for the single best idea anyone has ever had, I’d give it to Darwin, ahead of Newton, Einstein, and everyone else.

In a single stroke, the idea of evolution by natural selection unifies the reality of life, meaning and purpose with the realm of space and time, cause and effect, mechanism and physical law.”

Daniel Dennet, Darwin’s Dangerous Idea

1868 Mendeleev proposes the Periodic Table of the Elements

- **vastly superior to the primitive beliefs of the elements being air, earth, fire and water**
- **introduces order into inorganic chemistry**

The Death of Spontaneous Generation

- **1861 Pasteur showed wheat would not ferment after being boiled**
- **germ theory of disease: the greatest medical discovery of all time**
- **1864 Lister proposes surgical sepsis**

1865 The American Civil War

• Divine Punishment versus Germ theory of disease

- disease was divine punishment for sins**
- 1876 Robert Kock proposes the germ theory of disease**
- Queen of England gets vaccinated against smallpox**
- she chooses vaccination, even if it meant thwarting God's will**
- set the stage for acceptance by the masses**

- **Mendel: Laws of Genetics**
- **Gregor Mendel, a monk**
- **proposed hereditary units now called genes**
- **Laws of mechanism of evolution**
- **presented 1856, neglected until 1900**

1903 Wright brothers fly

•1930 Evolution demonstrated in the Laboratory

- Dobzhansky**
- adaptive genetic changes in large populations of fruit flies as a result of controlled environmental changes.**

• **1962 Crick and Watson**

- **discover the chemical structure of DNA**
- **Linus Pauling shows how evolutionary history of life might be read by comparing the DNAs of various organisms**

Summary: Milestones in Our Understanding of the Earth

- **round not flat earth**
- **planets not moved by angels,
followed laws**
- **vast age of the earth**
- **uniform processes, not catastrophe**

Summary: Milestones in Our Understanding of Life

- **disprove spontaneous generation**
- **cellular theory of life**
- **germ theory of disease**
- **evolution**

A Summary: Advancement of Understanding

- each controversy lasted hundreds of years**
- religion was a force of suppression**
- the scientific view won in the end**
- each resulted in a major paradigm shift**

Advancement of Understanding, continued

- **religious viewpoint lost credibility**
- **less literal interpretation, more as a metaphor**
- **religion was less of a force acting in our lives**

Intellectual Advancement

- **where science encroaches on the domain of religion**
- **perpetual conflict: science versus religion**
- **science provides a better explanation to fit the facts**

A Collision of Ideas:

- **Science observes and codifies observable data.**
- **Scientific laws begin to encroach upon religious dogma.**
- **This begins to compromise certain theological beliefs.**
- **It becomes a difficult confrontational problem for religion.**

Summing up History:

- **For thousands of years there has been a struggle between religion and science.**
- **The fundamental difference in these approaches is:**
 - **religion seeks supernatural causes**
 - **science seeks natural causes.**
- **Throughout history, in issue after issue, theological thought has been swept away.**

Science wins, Religion loses

- **In each case there were major paradigm shifts:**
 - **Flat earth, geocentric universe**
 - **witches, devils, demons and spirits**
 - **lightning and disease being the wrath of God.**
- **Each took centuries to replace the old religious based beliefs.**
- **In each case, scientific explanations won in the end.**
 - **liberated man from ignorance and**
 - **dependence on supernatural explanations.**

Timeline: Origin of Scientific Thought

- **500 to ~1700 Inquisition causes Dark Ages**
- **13th century Roger Bacon discovers gunpowder**
- **1400 Black Death**
- **1519 Magellan: the world is round**
- **1542 Leonardo da Vinci**

- **1543 Copernicus: earth is not center of universe**
- **1595 Shakespeare**
- **1600 Galileo persecuted by Catholic Church**
- **1628 Harvey: Circulation of the blood**
- **1674 Leeuwenhoek discovers microscopic life**
- **1687 Newton: Laws of Gravity**
- **1692 Salem witchcraft**

- **1774 Lavoisier shows fire to be union of the burning material with oxygen**
- **1756 Mozart**
- **1769 steam engine**
- **1774 Priestly discovers oxygen**
- **1778 Linnaeus categorizes living things**
- **1796 Jenner first smallpox vaccination**
- **1815 Napoleon**

- **1826 Beethoven's 9th Symphony**
- **1830 first railroad**
- **1837 Schleiden and Schwann formulate cellular theory of life**
- **1840 Malthus: struggle for existence**
- **1842 -1847 use of nitrous oxide, ether and chloroform for anesthesia**
- **1859 Darwin publishes Origin of Species**
- **1865 Civil War**

- **1868 Mendeleev devises the periodic table of the elements**
- **1869 Pasteur and Koch: bacteriology**
- **1871 Darwin publishes Descent of Man**
- **1879 Edison invents the electric light**
- **1895 Roentgen discovers X-rays**
- **1903 Wright brothers first fly**

- **1900 Mendel formulates laws of genetics**
- **1901 Marconi transmits radio signals across the Atlantic**
- **1559 - 1948 Catholic Church publishes List of Forbidden Books**
- **1962 Crick and Watson discover DNA**
- **1992 Church reverses condemnation of Galileo**
- **1996 Vatican reaffirms ban on contraception**

Summary: Religion and Science

Religion

- **based on belief**
- **not amenable to analysis by scientific method**
- **stands forever as ultimate truth**
- **unquestioned**
- **immune to critical observation**

•Theology

- **true for all time, in spite of evidence which may arise that conflicts**
- **the art of fitting new findings into old explanations**
- **I've got my mind made up, don't confuse me with the facts**

•Science

- a tentative set of theories and hypotheses
- all vulnerable to the impact of new information
- based on observation
- self correcting
- if evidence builds up against a theory, a better one is sought
- science is the best available approximation for the truth

Scientific Literacy

- **Only 1 of every 13 high school student takes physics.**
 - **Not true for our industrial competitor nations.**

My advice: take physics, chemistry, biology

- **These form the foundation of your understanding of the world, your thoughts, your basis of decisions.**
- **Base your understanding of the world in terms of natural causes.**
- **Not supernatural causes**

Learn technology, not psychic phenomena

- Studying things like astrology, numerology, psychic phenomena is reverting back to ideas which were shown to be inaccurate centuries ago.**
- You are choosing to ignore the tools that prove to work in building the marvels of our age, which would amaze them with things which are commonplace for us.**
- Your capabilities become similar to a peasant of the medieval centuries when you revert to the explanations of the world which they used.**

Time for a New Paradigm?

- **we need a new philosophy**
- **relevant to problems facing us today**
 - **help not a hindrance**
 - **incorporates Man as part of Nature**

Time for a New Paradigm?

- **based on present biological and medical concepts**
- **based on science not dogma**
- **directly addresses:**
 - **population**
 - **pollution**
 - **balance between man and nature**

•Origins of Scientific Thought

- Milestones in the Development of Modern Understanding**
- Paul Storey**