Rise of Science in the 17th and 18th Century

New Systems of Philosophy and Experimental Science

The scientific revolution in this period was responsible for advances from supernaturalism to secularism, from theology to science, from hope of heaven and fears of hell to plans for the enlargement of knowledge and the improvement of human life.

Will and Ariel Durant, The story of civilization

17th Century Beginnings

Fusion of theoretical and applied sciences

Development of new scientific instruments:
- barometer, air pump, sextant

Technology allowed humans to move outside visual world
- Astronomy via the telescope invented by Janssen, a Dutch spectacle maker in 1590
- Discoveries in the heavens by Galilei Galileo (1564–1642)
- Biology via the microscope

Science became an important force in Western Civilization

Science Societies: Royal Society of London founded 1662

Francis Bacon 1561–1626 (English)
Thomas Hobbes 1588–1679 (English)
Rene Descartes 1596–1650 (French)
Baruch Spinoza 1632–1677 (Dutch)
Gottfried Leibnitz 1647–1716 (German)
Isaac Newton 1642–1727 (English)
Robert Hooke (1634–1703)

English experimental physicist with wide interest in science
Motion of heavenly bodies regarded as a problem, discovers
universal gravitation, feuds with Newton.
Examines a wide range of materials with microscope
Discovers the cell.
Recognizes that plant tissues are “all perforated and porous, much
like a honeycomb” Gave the name cells to these pores,
Referred to cell walls as interstitia, but not considered a
constituent part of the cell, “for in several of these vegetables
whilst green, I have with my microscope plainly enough
discovered these cells filled with juices, and by degrees sweating
them out.”
Publishes results in *Micrographia* (1665)

Anton Van Leeuwenhoek (1632–1723)

Dutch microscopist; Father of Scientific
Microscopy
Constructs 400 microscopes, bequests 26
to Royal Society of London
Refers to animacules (little animals)
Extended Malphighi's demonstration of
blood capillaries, later describe blood
 corpuscles
Life cycle of aphids
Stem structures in monocots and dicots
Polyembryony in citrus
Male spermatozoa
First drawing of bacteria
Italian physician, anatomist, physiologist, microscopist.
First to utilize microscope to study animal and plant structure and histology (tissues structure)
Layers of tissues in leaves and young shoots found to be continuous with those of the main stem
Distinguishes fibers, tubes and other constituents of wood
First to understand the food function of leaves
Observes stomata, nodules in legume roots
Relates ovule to seed and carpel to fruit

Marcello Malphighi (1629–1684)

English physician, anatomist, and physiologist
Co-founder of plant anatomy with Malphighi
Secretary of Royal Society of London
Compares plant and animal tissue in essays before Royal Society (1671, 1672, 1674)
Tissue histology, describes parenchyma
Note that pollen is bee-bread
Observes scattered vascular bundles in monocots.
Resin ducts in pine
Extracts chlorophyll using oil as a solvent

Nehemiah Grew (1642–1712)

Joseph Pitton de Tourneford (1656–1708) suggests flowers and fruits as basis of classification, although he failed to understand sexuality in plants, began study of plant systematics beyond genera.

Plant Classification
Rudolph Camerarius (1665–1721)
Professor Botanic Gardens at Tübingen, 1688
Through study of dioecious and monoecious plants explains function of pollen and egg; considered apices with pollen as male, first modern understanding of plant sexuality

Babylonian pollinating date palm

Carolus Linnaeus (Carl Von Linne)
1707–1778
Swedish botanist and physicians
Curator of the gardens of the University of Lund at age 23
Traveled in Lapland, Holland, England and France
1741 Head of Botany of the University of Upsula
Father of Taxonomy
Established groups of organism that depended upon structural or morphological similarities and differences. Basic taxonomic criteria for groupings were based on morphology of reproductive parts, parts least apt to be influenced by environment. However, his system was artificial and is no longer being used; depended on no. of stamens and carpels as a method of grouping plants. Credited with establishment of binomial nomenclature. *Systema Naturae* 1735, *Fundamenta Botanica* 1736, *Genera Plantarum* 1737, *Classes Plantarum* 1738, *Philosophia Botanica* 1751. Named more than 1300 different plants (and as many or more animals); many names still used.

**Hybridizing**

Joseph Gottlieb Koelreuter (1733–1806)  
First systematic experiments on plant hybridization using tobacco (*Nicotiana paniculata × N. rustica*)  
He demonstrated that hybrids resemble both parents.  
Experimentally verified the genetic contribution of pollen.  
First observed hybrid vigor (heterosis).

**Plant Physiology**

Joachim Jung (1587–1657) argued that plants have no soul; studies absorption by roots. M. Malphighi and N. Grew, established leaves as producers of food.  
J.B. van Helmont (1527–1644)  
Infamous experiments with wrong conclusions. Assumes carbon fixation from air and oxygen and hydrogen from water.
Stephen Hales (1671–1761)

English physician, chemist, inventor, and country vicar
Studies physiology on foundation of Grew’s anatomical work
First to use quantitative results: studies movement of sap, root pressure, transpiration, flow of nutrients by girdling
Contended plants draw some parts of the nourishment form air and that leaves absorb light

*Statistical Essays, Vegetable Staticks (1727)*

Experiments, to find out the force with which trees imbibe moisture

Source: Hales, Vegetable Staticks, 1727.

Joseph Priestly (1733–1804)

Proved that oxygen (dephlogisticated air) is produced by plants
Discovers photosynthesis and respiration
History of Horticulture: Lecture 29

Era of Botanical Exploration

Hans Sloan (1660–1750)
Collected 800 species from West Indies.

James Cunningham, sent to China in 1698 to investigate flora

George Eberhard Rumph (Rumphius) 1628–1702, known as “Pliny of the Indies,” explores Moluccas, describes 1700 species, stationed on small island of Amboina

Herbarium Amboinense 1741–1755

Sir Joseph Banks (1743–1820)

Wealthy English landowner
President Royal Society for 42 years; dictator of English Botany

Explored Newfoundland, Brazil, New Zealand, and Australia

Plant explorer sailing with Captain Cook in the Endeavor at age of 25

Unpaid director of Kew Gardens
Considered greatest Englishman of his time by foreign scientists
Banksia coccinea