

PEOPLE IN SCIENCE

CELL THEORY

John Needham claimed that spontaneous generation (life from inorganic matter) could occur under the right conditions. He sealed a bottle of gravy, boiled the gravy (killing all the microorganisms), and after a few days, the bottle was teeming with microorganisms.

Francesco Redi hypothesized that maggots arose from eggs, not from meat. He believed that flies laid their eggs (very small) and the maggots arose from the eggs. He placed pieces of meat in several jars. He left some jars open to the air, other jars he placed gauze on the top. The gauze prevented the flies from landing. After a few days, the meat was spoiled and maggots were only found in the uncovered jars.

Lazzaro Spallanzani believed that Needham was wrong and that all the microorganisms hadn't been killed during the boiling process. He prepared the gravy identical to Needham. His results were contradictory to Needham. The open jar: life, the sealed jar: no life. He concluded that the microorganisms entered the jars from the air.

Louis Pasteur finally disproved spontaneous generation with his experiments using the swan necked flasks.

Anton van Leeuwenhoek built the first microscope and discovered tiny organisms, invisible to the unaided eye, lived in ponds, soil, and his own body. He proposed that these came from the reproduction of others of their kind.

Robert Hooke looked at thin slices of plant stems. He saw thousands of chambers. Hooke called these cells because they reminded him of the small rooms in a monastery called cells.

Robert Brown discovered a dark structure near the center of the cell—nucleus.

El Gorter and F. Grendel proposed that the cell membrane was a bilayer.

S.J. Singer and G. Nicolson proposed the mosaic model of the cell membrane.

Matthias Schleiden stated that all plants are made of cells.

Rudolf Virchow stated that all cells arise from the division of preexisting cells.

Lorenz Oken put the final touches on the cell theory.

EARLY LIFE

Alexander Oparin published a proposal of how life might have arisen, starting with simple molecules on the early earth and working up through more complex levels of organization: monomers to polymers to aggregates of polymers to living cells.

J.B.S. Haldane echoed Oparin's work.

Stanley Miller in 1953, Miller built a laboratory apparatus that represented the early earth on a small scale. He had a primitive ocean and atmosphere. He shocked his apparatus with electricity (lightening). After a week, the 'ocean' contained organic molecules.

Harold Urey also tested the Oparin-Haldane model.

VIRUS

Adolf Myer was a German scientist who sought cause of Tobacco Mosaic disease. Discovered that disease was contagious—no microbes. Caused by a virus.

Dimitri Ivanowsky was a Russian scientist who passed TMV through filter designed to filter out bacteria.

Martinus Beijerinck was a Dutch scientist who discovered that pathogen for TMD can reproduce and the pathogen was inactivated by alcohol. The pathogen was simpler and smaller than bacteria.

Mendel Starely was a US scientist who crystallized the infectious part of TMV.

Edward Jenner was an English scientist who noticed that milkmaids who had cowpox were resistant to small pox.

DNA

Frederick Griffith studied *Streptococcus pneumoniae*. He could distinguish between two varieties, or strains. One strain produced smooth colonies and the other strain appeared rough. The smoothness was caused by a polysaccharide that surrounded the cells capsule. Only the smooth strain was pathogenic. He heat killed some smooth cells and mixed them with living rough cells. The rough cells were transformed by the dead smooth bacteria. First hard evidence of genetic material.

Oswald Avery tried to identify the transforming agent. In 1944 Avery and Maclyn McCarty and Colin MacLeod identified the agent as DNA.

Alfred Hershey and Martha Chase discovered that DNA was the genetic material of a phage (T2). They used radioactive isotopes to tag the DNA of a T2 phage. They concluded that the DNA of the virus is injected into the host cell. This DNA caused the cells to produce additional viral DNA and proteins. This was evidence that the nucleic acids, not proteins, were the heredity material (at least in viruses).

Erwin Chargaff stated that DNA is a polymer of monomers called nucleotides. Each nucleotide is composed of three components: nitrogenous base, pentose sugar, and a phosphate group. The nitrogenous bases were one of the four bases: adenine, thymine, guanine, and cytosine. He studied the base concentration in different species.

James Watson and Francis Crick suggested that DNA was a double helix. The double helix is composed of a sugar-phosphate backbone with rungs of nitrogen bases held together by hydrogen bonds. Used the X-ray crystallography from Rosalind Franklin.

Matthew Meselson and Franklin Stahl demonstrated that DNA replication was semi-conservative.

Archibald Garrod, a British scientist, suggested, in 1909, that genes dictate phenotypes through enzymes that catalyze specific chemical processes in the cell.

Okazaki discovered lagging strand synthesis.

Barbara McClintock discovered transposable genetic elements.

GENETICS

Gregor Johann Mendel is known as the father of modern genetics. A monk who worked with peas. Came up with his Principle of Dominance, Law of Segregation and Law of Independent Assortment.

EVOLUTION

Carolus Linnaeus, the father of Taxonomy. He believed that species were permanent creations. He developed his classification scheme only to reveal God's plan.

Jean Baptiste Lamarck published his theory of evolution in 1809. He believed that evolution responded to organisms' needs. His theory was based on two ideas: use and disuse and inheritance of acquired characteristics.

Charles Lyell demonstrated that the earth was very old and it had changed over time. The book that influenced Darwin was *Principles of Geology*. This book allowed Darwin to appreciate the geological phenomena he observed on his voyage.

Thomas Malthus was an economist that influenced Darwin. Malthus observed that babies were being born at a faster rate than the people were dying. If the human population continued to increase in that way, sooner or later there wouldn't be enough food or living space. The only conditions that would prevent the endless growth were famine, disease and war. These observations were called the Malthusian Doctrine.

Charles Darwin sailed on the *HMS Beagle* as a companion to the captain. After the Doctor quit, he became the naturalist. Observed many different plants and animals. At the Galapagos Islands observed finches, iguanas and tortoises. By the 1840's he worked out the major features of the theory of Natural Selection as the mechanism of

Evolution. Under the advisement of Lyell, he published his ideas. In 1858 Alfred Wallace sent a manuscript to Darwin asking for evaluation. The manuscript described Wallace's theory of Natural Selection almost identical to Darwin's. Lyell presented both Wallace's published manuscript and Darwin's unpublished manuscript to the Linnaean society of London (July 1, 1858). Darwin quickly finished *The Origin of Species* and published it in 1859. So although Wallace published the idea first, Darwin supported it more extensively. Darwin is known as the main author.

Alfred Wallace developed his own theory of evolution by means of natural selection. See above.

Niles Eldredge and Stephen Jay Gould developed the theory of Punctuated Equilibrium. In this theory there are long periods of time of little or no change in species, punctuated by short periods of time of rapid change.

PLANT HORMONES

Darwin and his son **Francis** observed that grass seedling could bend to the light only if the tip of the coleoptile was present. They hypothesized that some signal was being transmitted downward from the tip to the elongating region.

Peter Boysen-Jensen tested the above hypothesis and demonstrated that the signal was some kind of mobile substance. He separated the tip by a block of gelatin, this prevented cellular contact, but allowed substances to move through it. The tip still moved to the sun. If the tip was separated by some mica, no growth to the light.

F.W. Went extracted the chemical messenger for phototropism. He did the same experiment as Boysen-Jensen. Went chose the name Auxin for the chemical.

Kenneth Thimann purified and determined the structure of Auxin.

ANIMAL BEHAVIOR

Konrad Lorenz, Niko Tinbergen, and Karl von Frisch discovered that animals carry out many behaviors without ever having seen them performed. Many behaviors are innately programmed. These behaviors are purposeful because they are beneficial, they are carried out in ways that show the animal is unaware of the significance of their actions.

Konrad Lorenz conducted an experiment with geese that showed imprinting behaviors.

Ivan Pavlov developed the classical conditioning experiment.

B.F. Skinner introduced trial and error learning or operant conditioning. He placed mice in a 'Skinner box' that had levers. Some levers lead to a reward, mice learned to push these leers.

Karl von Frisch discovered the purpose behind the honeybee dance.

E.O. Wilson published a text called *Sociobiology*, which describes the social systems of various animal species. The book describes social behavior as an evolutionary process. He states that behavioral characteristics exist because they are expressions of genes that have been kept by natural selection.