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 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 all the microorganisms hadn't been killed during the boiling process as Needham hypothesized. Spallanazani prepared the gravy experiment identical to Needham. His results contradicted Needham's. The open jar—life, the sealed jar—no life. He concluded that the microorganisms entered the jars from the air.

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

Anton van Leeuwenhoek built the first microscope and discovered that 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 and saw thousands of chambers. Hooke called these 'cells' because they reminded him of the small rooms in a monastery.

Robert Brown discovered a dark structure near the center of the cell—the 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, a German naturalist whose writings foreshadowed cell theory.

EARLY LIFE

Alexander Oparin published a proposal of how life might have arisen, stating 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 and was one of the founders of population genetics.

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, along with Stanley Miller, tested the Oparin-Haldane model and showed that the hypothesis for the origin of life was feasible.

VIRAL

Adolf Myer was a German scientist who sought the cause of Tobacco Mosaic disease. Discovered that disease was viral, not bacterial in origin.

Dimitri Iwanowski was a Russian scientist who passed TMV through filter designed to filter out bacteria, thus ruling out possibility of a bacterial agent causing the virus as previously thought.

Martinus Beijerink was a Dutch scientist who discovered that the pathogen for TMD can reproduce and that it is inactivated by alcohol.

Mendel Starely was an American 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 pneumonia. 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. This was the first concrete evidence of genetic material.

Oswald Avery tried to identify the transforming agent for life. In 1944 Avery, 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 that genes dictate phenotypes through enzymes that catalyze specific chemical processes in the cell.

Reiji and Tuneko Okazaki discovered lagging strand synthesis.

Barbara McClintock discovered transposable genetic elements.

GENETICS

Gregor Johann Mendel is known as the father of modern genetics. He developed the Principle of Dominance, Law of Segregation, and Law of Independent Assortment through his extensive work with peas.

EVOLUTION

Carolus Linneaus, 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 that it changed over time. His book, *Principles of Geology*, influenced Darwin.

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

Charles Darwin, while sailing on the *HMS Beagle*, observed many plants and animals. These observations led him to theorize that natural selection was the mechanism of evolution. Under the advisement of Charles Lyell and Robert Hooker, Darwin began to write about his ideas in 1840. 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. Charles Lyell presented both Wallace's published paper and Darwin's unpublished manuscript to the Linnaean society of London in 1858. Darwin quickly finished *The Origin of Species* and published it in 1859. Although Wallace published first, Darwin was able to support the hypothesis more extensively. Thus, Darwin is known as the main author.

Alfred Wallace was an English naturalist who developed and published his own theory of evolution by means of natural selection.

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

Charles and Francis Darwin 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, then growth did not occur.

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 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—innate behavior. These behaviors are purposeful and beneficial, and they are carried out in ways that show the animal is unaware of the significance of their actions.

Konrad Lorenz conducted an experiment illustrating 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. The mice learned to push only the levers that led to a reward.

Karl von Frisch discovered the purpose behind the honeybee dance—communication.

E.O. Wilson published *Sociobiology*, which describes the social systems of various animal species. The book details social behavior as an evolutionary process.