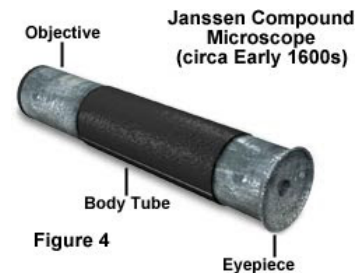
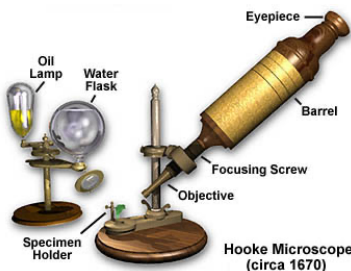


Quest for the smallest possible – an history of microscopy

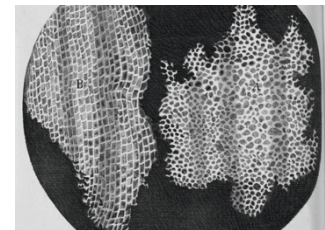
In 1595, Zacharias JANSSEN, a Dutch spectacle maker and lens manufacturer, is believed to be one of the first to have created the optical microscope (OM) with two converging lenses, having had the idea of looking through a “magnifying glass” (with a first lens) not at the object itself, but at the already magnified image of that object (using a second lens). This microscope magnified the image 3 to 10



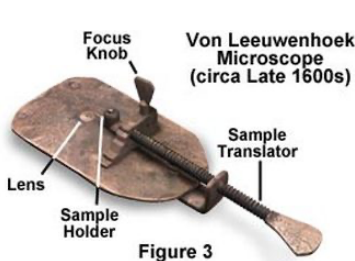
times.



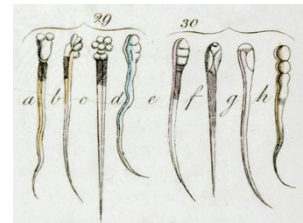
Approximately 50 years later, Robert HOOKE, an English multidisciplinary scientist, is known to be one of the first to improve Janssen’s apparatus, in building and assembling a microscope composed of multiple lenses (usually three), capable of magnifying up to 30 times.



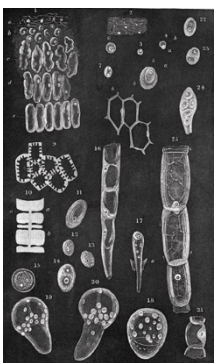
This allowed him to be the first to observe and describe a cell (the cell of cork in wood) and to use the term “cell” to name the “small juxtaposed boxes” he observed (which he named thus because they reminded him of the shape of monks' cells in monasteries). He began to say that living beings are composed of one or more cells.



Around 1670, Antoni van LEEUWENHOEK, a Dutch merchant and scientist, developed microscope lenses of a quality and power unknown until then. His microscopes could magnify images up to 300 times. He was able to observe protozoa, bacteria, and spermatozoa, which he called animalcules, and to discover globular structures inside the cells, which later turned out to be nuclei.

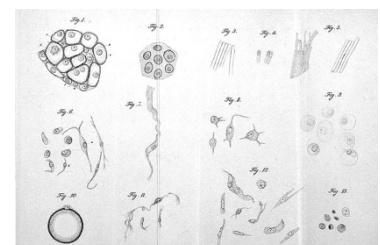


Optical microscopes improved during the following centuries, until reaching magnifications up to x1500 to x2000. This allowed several discoveries on the structure of life and their metabolism:



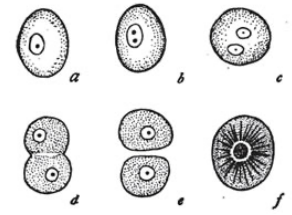
In 1831, Matthias Jacob SCHLEIDEN, a German botanist, observes plants under an optical microscope and discovers that they are all made up of cells... while Theodore SCHWANN, a German zoologist, observes animal tissues under an optical microscope and discovers that they are also all made up of cell.

In 1839, Schwann published his theory that the cell is the structural and functional unit of all living things (plants and animals) and that it has a nucleus.

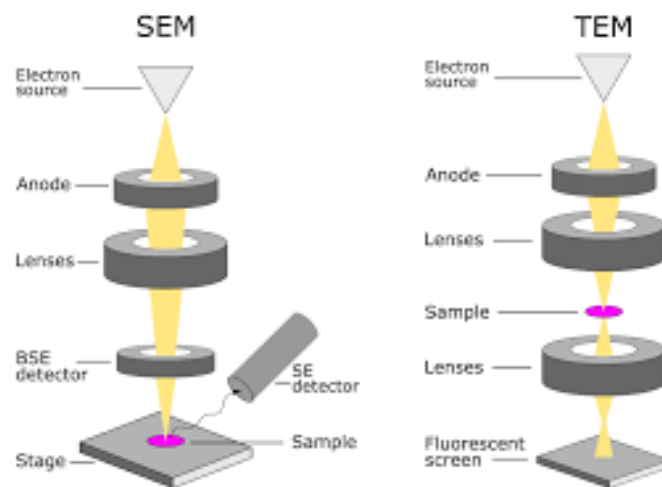


What is life made of?

In 1855, Robert REMAK, a German scientist of Polish origin, after staining the plasma membrane of cells, succeeded in observing cell division under an optical microscope: he thus demonstrated the existence of a plasma membrane and proved that at least some cells originate from the division of other cells. His work was not recognized for its true value. And in 1855, Rudolf VIRCHOW, German physician, scientist, and politician, reaffirms that “*omnis cellula e cellula*,” meaning that all cells originate from other pre-existing cells...

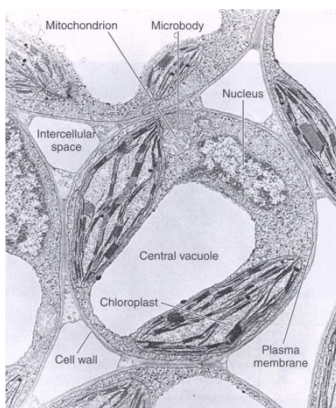


A bit less than a century later, after physicists introduced quantum mechanics and discovered the electron and all sub-structures of the atom, a huge step was made with the idea of using electrons instead of light to explore matter.



In 1931, German engineers Ernst Ruska and Max Knoll invent the transmission electron microscope (TEM) (which uses a beam of electrons instead of light): this microscope can magnify images up to 5 billion times and produce black-and-white 2D images. And a few years later, in 1937, Manfred von Ardenne, a German physicist and inventor, invented the scanning electron microscope (SEM), which can magnify images up to 100,000 times and produce black-and-white 3D images.

Note: unlike optical microscopy, this method can only be used on dead samples.



This allowed the observation of organelles and ultrastructures of the cell, and, for example, in 1972, lead SINGER and NICOLSON to propose a fluid mosaic model for the membrane structure.

