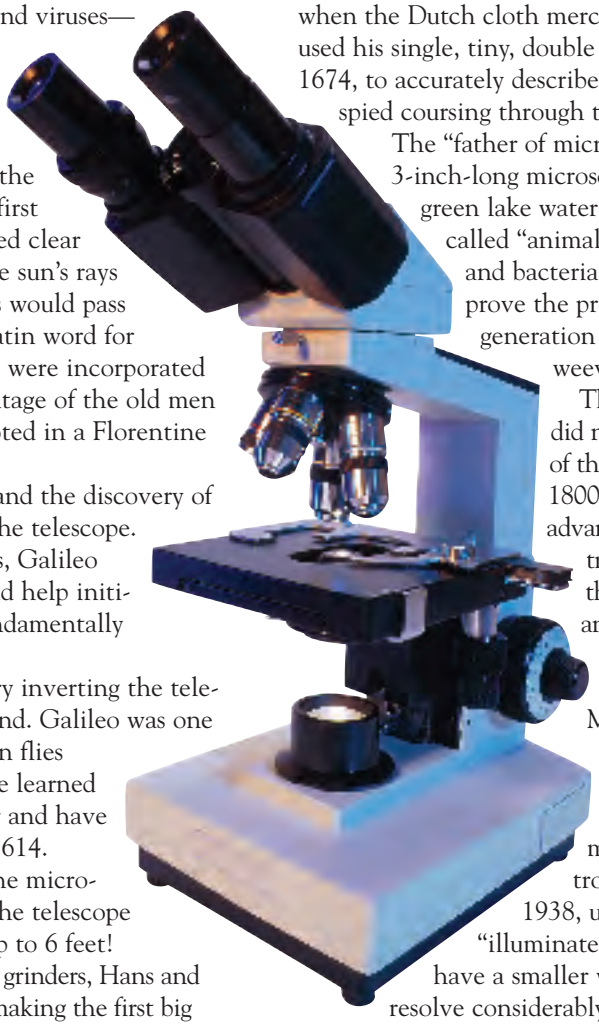
The Microscope

Its invention opened windows into unknown worlds.

By Sue DePasquale

Unlike any other invention, the microscope has unveiled the very building blocks of life. Peering into the mysterious world of the microcosmos, scientists over the centuries have gained a window on the previously unfathomable—cellular processes, the workings of bacteria and viruses—making possible the major advances in biology and medicine that we take for granted today.



While it's impossible to say for sure who invented the microscope, the concept behind it goes back to the first century A.D., when the Romans used clear pieces of "burning glass" to focus the sun's rays and start fires. Hundreds more years would pass before "lenses" (derived from the Latin word for lentil, whose shape they resembled) were incorporated into spectacles, "for the great advantage of the old men when their sight grows weak," as noted in a Florentine manuscript of 1299.

Fast forward to the 16th century and the discovery of that great astronomical invention, the telescope. Gazing out upon the moon and stars, Galileo Galilei made observations that would help initiate the scientific revolution that fundamentally changed our world.

It didn't take long for people to try inverting the telescope to enlarge objects closer at hand. Galileo was one of them. "With this tube, I have seen flies which look as big as lambs, and have learned that they are covered over with hair and have very pointed nails," he reported in 1614. Because these early forerunners of the microscope were based on the reverse of the telescope they were heavy and very long — up to 6 feet!

The Dutch father/son team of lens grinders, Hans and Zacharias Janssen, are credited with making the first big advance on the simple microscope by combining two lenses—the "ocular" near the eye, and the "objective" near the sample.

The age of experimentation had arrived and the time was ripe for Englishman Robert Hooke and his engaging *Micrographia*, published in 1665. In a series of 57 dramatic illustrations, Hooke made visible for the first time the anatomy of a flea, the eye of a fly, the structure of feathers. To describe the honeycomb pores of cork, he coined the term "cells" (named for the tiny monastery rooms they reminded him of). Hooke's drawings would remain the standard in scientific textbooks well into the 1800s.

Next came some of the first big advances in biology, when the Dutch cloth merchant Anton van Leeuwenhoek used his single, tiny, double convex lens microscope, in 1674, to accurately describe red blood corpuscles, which he spied coursing through the capillaries of a rabbit's ear. The "father of microscopy" would go on to use his 3-inch-long microscope to peer into a vial of cloudy green lake water to observe and describe what he called "animalcules" (known today as protozoa and bacteria). And he would help to disprove the prevalent theory of spontaneous generation when he observed fleas and weevils develop from tiny eggs.

The next observations of bacteria did not come until the improvements of the compound microscope in the 1800s. Among the most important advances: In the United States, country doctor Robert Koch discovered the bacilli that caused tuberculosis and cholera, two of the major killers of his time; the findings earned him a Nobel Prize in Medicine in 1905.

Today, advances in technology have made possible new microscopes with incredible magnification power. The electron microscope, first developed in 1938, uses electrons rather than light to "illuminate" an object. Since electrons have a smaller wavelength than light, they can resolve considerably smaller structures, making it possible for the transmission electron microscope, for example, to magnify objects up to 1 million times. And the scanning tunneling microscope, developed in 1981 by scientists Gerd Binnig and Heinrich Rohrer, now gives researchers 3-D images of objects down to the level of a single atom.

By illuminating everything from cell division to the function of nerve cells, today's advanced microscopes continue to unlock nature's secrets.