In the second half of the 17th century, several important observations established the groundwork for the cell theory of the future. The enabling factor was the progress in optics, a mainstream field of the emerging science of that time. Optics was applied, on the one hand, to the study of astronomy and in the construction of telescopes, and, on the other, in the development of microscopy. An Englishman, Robert Hooke (1635–1703), is credited with the first use of the term “cell,” when he described his microscopical images of slices of cork (1–3). Hooke was a polymath. His interests ranged from astronomy to architecture. In 1662, he became Curator of Experiments at the recently formed Royal Society. He was Professor of Geometry at Gresham College from 1665 until his death. He was also the City of London Surveyor after the Great Fire of 1666. In 1665, Hooke published Micrographia: or Some Physiological Descriptions of Minute Bodies Made by Magnifying Glasses, the first book that used both text descriptions and extraordinary illustrations to present instrumental images of a previously unseen world (4). In the introduction to Micrographia, Hooke wrote about the importance of instruments (5):

_The next care to be taken in respect of the Senses, is a supplying of their infirmities with Instruments, and, as it were, the adding of artificial Organs to the natural; this in one of them has been of late years accomplisht with prodigious benefit to all sorts of useful knowledge, by the invention of Optical Glasses. By the means of Telescopes, there is nothing so far distant but may be represented to our view; and by the help of Microscopes, there is nothing so small as to escape our inquiry; hence there is a new visible World discovered to the understanding._

Another major contributor to elucidating the nature of cells was a Dutchman from the city of Delft—Antonie van Leeuwenhoek (1632–1723) (6). van Leeuwenhoek was a businessman with no scientific training, but he had a passion for microscopes, extraordinary curiosity, and an excellent ability to describe his observations. He was a contributing layman among professionals, a scientific equivalent of Henri Rousseau (“Le Douanier”) in the bohemian arts community of 19th-century Paris.

van Leeuwenhoek constructed simple single-lens microscopes (as opposed to the compound ones used by Hooke), yet his lenses were of better quality and reportedly achieved magnifications of up to 275 times. Beginning in 1673, van Leeuwenhoek sent his observations to the Royal Society, and in 1680 he was elected as a member. His famous observations of pond water led to the first descriptions of bacteria and protozoa, which he named “animalcules.” He investigated saliva, sperm, and many other biological samples. His vivid descriptions of bacteria in dental plaque material could well serve as an enticement to dental hygiene today.

A contemporary resident of Delft was Johannes Vermeer (1632–1675), the son of an innkeeper and picture dealer. Johannes later took over his father’s business (7, 8), but he was most of all a painter. He was admitted to the local Guild of Saint Luke in 1653 and eventually became a successor (not a pupil as is sometimes implied) of the most celebrated Delft painter of the time, Carel Fabritius, who unfortunately died in an explosion of the city arsenal in 1654.

Vermeer was particularly influenced by the painters of Amsterdam and Utrecht, the latter having adopted an Italianate style. Vermeer was a recognized expert in Italian art. His early paintings addressed religious themes. He then turned to genre scenes of everyday life, for which he is largely known. Later in his life, Vermeer created allegorical works, such as The Allegory of Painting (now in the Kunsthistorisches Museum, Vienna) (9).

Working mostly in his studio, Vermeer created meticulously composed works, in which domestic scenes look almost like still lifes. These paintings have a unique poetic, abstract quality and very little narrative. Vermeer was particularly adept at rendering textures and the effects of light. To suggest textures, he used small dots of paint, technically known as “pointillés.” Vermeer was a sophisticated colorist and often used more than one ground layer of paint to obtain subtle color interactions. He made laborious adjustments to his paintings and took a long time to create each one: Only 35 paintings are currently attributed to him.

_Woman Holding a Balance_ (Fig. 1), painted around 1664, typifies his genre paintings (10). The painting is calmly vague, poetic, and is open to interpretation. It works through its careful composition, attention to the effects of light, and masterly rendering of textures.

Vermeer made no preparatory drawings. His connection with optics is through the influence on his...
work of an instrument known as the “camera obscura,” a darkened chamber that admits light through a pinhole or a lens. It can project onto a surface an image that can then be traced. Many established painters used the camera obscura. Although there is no direct evidence that Vermeer used one to trace images he intended to paint, the work of Steadman (which involved a reconstruction of Vermeer’s studio) suggests that he did (11).

What has been established, however, is that Vermeer’s paintings include optical distortions that the camera obscura is known to produce. In contrast to artists who corrected such distortions, Vermeer used them as a means of expression. Thus, his paintings show occasional fuzziness, subtle shifts of focus, or a flattening of perspective. In this manipulation of real-life views, Vermeer’s work is an early precursor of abstraction.

There is no direct evidence that Vermeer and van Leeuwenhoek ever met, although that they did has often been inferred. They lived close to each other and shared an interest in lenses. The fact that van Leeuwenhoek was appointed executor of Vermeer’s estate after the painter’s death also suggests they had (12).

For a long time after his death, Vermeer was forgotten, probably because of the small number of his works and thus the less-than-critical mass required for residence in the collective memory. That changed when French realists enthusiastically embraced his work after it was rediscovered in the 19th century. Today, Vermeer is ranked as one of the best painters of all time. His painting Girl with a Pearl Earring became iconic through the book of the same name by Tracy Chevalier. The subsequent movie directed by Peter Webber was distinguished, most appropriately, by its extraordinary cinematography, which was nominated for an Academy Award in 2003.

Thus, the new developments in optics allowed people to see 3 different worlds. There were the worlds of astronomy and microscopy, both of which visualized previously unseen universes. The third of these worlds was the poetic images of Johannes Vermeer, which have become part of our visual vocabulary. The influence of optics on the work of Vermeer is just one of the many roundabout ways in which science permeates culture.

References

DOI: 10.1373/clinchem.2012.199851