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Medicine in Stamps
Antoni van Leeuwenhoek (1632-1723): Father of Microscopy

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First came the theorists and animal dissections. Next, the elegant vivisection of Vesalius that established human anatomy as an indispensable science. Then there was William Harvey, who taught us to observe, hypothesise, and experiment. These were men of prominence, recipients of the best education of their day. So who would have thought that the next landmark advancement in the history of Medicine would come from an unschooled Dutchman named Antoni van Leeuwenhoek? With his microscopes, this common man would probe, with passion and accuracy, the world of miniatures. By doing so, he unleashed the disciplines of histology and microbiology, and laid the foundation for the great bacteriologic discoveries of Koch and Pasteur.

A man without schooling: Antoni van Leeuwenhoek was born on 24 October, 1632 in a little Dutch town called Delft. The son of a humble basket maker, he had little schooling and worked as an apprentice for a storeowner. He later became a shopkeeper of dry goods and subsequently worked as a civil servant, beginning as an usher to the alderman of the municipality of Delft.

The man himself was self-taught and did not attend university. He therefore lacked both a command of Latin, the language of science, as well as the rudiments of scientific knowledge. Despite his inability to read the works of his predecessors and to communicate with the scientists of his time, Leeuwenhoek succeeded with his hobby of microscopy in describing the invisible world of microbes which he named "animalcules". These observations he recorded in some 375 famous letters he wrote to the Royal Society of London and 27 to the Paris Academy of Sciences. For his contributions, he was awarded Fellowship in the Royal Society in 1680.

Perhaps because of his limited education, Leeuwenhoek was secretive about his work. Considered an eccentric, he never sold or allowed anyone to borrow his lenses. He lived his life in relative isolation and was described by his friend and admirer de Graaf, a prominent member of the Royal Society of London, in this way: "As a theorist he fails, as an observer he is supreme, as a worker he is jealous."

Adventures with the microscope: It was not until 1671 at the age of 39 that Leeuwenhoek began to pursue his hobby of microscopy. He enjoyed grinding lenses, which he did with passion and skill. His first microscope consisted of a magnifying glass made from a hand-ground lens taken from a glass globule. Over time, he managed to accumulate more than 500 lenses and built himself some 247 microscopes, although these were rudimentary types of magnifying apparatus capable of nearly 300-fold magnification. The resolving power was 1.4 microns, but subsequent instruments were capable of even finer resolution down to 1 micron.

Leeuwenhoek worked with superior lenses and accurately described what he saw, although he was not the first to experiment with magnifying lenses. Galileo, for example, used the microscope to describe flies ("as big as a lamb, covered all over with hair and very pointed nails") but had entirely overlooked its importance as an investigational tool.

Microbes: Leeuwenhoek was as patient as he was secretive and was said to have spent countless hours peering down his microscopes, observing fluids, organic tissues, and little insects. He accurately measured the size of red blood cells, described the structure of teeth, muscle fibres, and the lens of the eye. He also observed and described various micro-organisms in the mouth, including spirochetes and protozoa. He called them "animalcules" and estimated their size

by using a grain of sand as the standard of reference ($^1/_{30}$ inch).

In the late 17th Century, corn dust was believed to be the cause of death among sifters and measurers of grain. In 1692, Leeuwenhoek examined corn dust under his microscope, and discovered the presence of minute worms which he called "little wolves" – the alchemy term for aggressive substances. His observations underscored the link between inhaled small particles and pulmonary disease, although it is now recognised that the condition was most likely an allergic alveolitis.

Leeuwenhoek's microscopic discoveries were of critical importance for two reasons. First, they opened the world of investigation into pathogenic micro-organisms capable of causing infectious diseases in man ("Germ theory of Disease"). Second, they demolished the theory of spontaneous generation that was prominent at the time. Leeuwenhoek marvelled at the structural precision and perfection of the numerous small animal forms that he examined under his lenses, and offered his observations as proof against proponents of spontaneous generation. In his letters to the Royal Society, he wrote that a mite could no more arise from putrefaction than could an elephant from a particle of dust, a flea from sweat, or a horse from manure. Flies do not arise from carcasses, he wrote, nor cattle from stone. And mud could produce neither shellfish nor whales.

Spermatozoa: The initial discovery of spermatozoa was made in 1677 by a medical student by the name of Johan Ham who told Leeuwenhoek of the animalcules in human seminal fluid, thought to have arisen from putrefaction. Leeuwenhoek, however, was the first to make a detailed and accurate drawing of spermatozoa, and correctly identified them as a normal constituent of seminal fluid. He was also the first to speculate that fertilisation followed the penetration of ovum by the sperm, a theory at odds with the belief at the time that fertilisation occurred from vapors arising from seminal fluid. This theory of an unschooled lensmaker proved to be correct, supplanting the great William Harvey himself who believed that the egg was the sole source of new life.

Capillaries: Harvey's discovery of the circulation lacked the explanation of how the blood was able to enter the venous circulation from the arterial circulation because he did not know of the existence of capillaries. These were discovered by Malpighi and Leeuwenhoek.

Leeuwenhoek described the red blood corpuscles in 1674, but somehow, his letter on the capillary circulation escaped publication in the Philosophical Transactions (which published all of Leeuwenhoek's observations as contained in his letters to the Society) of the Royal Society of London. However, it appeared in the collection of Leeuwenhoek's works, the relevant portion of which reads as follows: "If now we see clearly with our eyes that the passing of the blood from the arteries into the veins, in the tadpoles, only takes place in such blood-vessels as are so thin that only one corpuscle can be driven through at one time, we may conclude that the same thing takes place in the same way in our bodies as well as in that of all animals."

Not its inventor, but its champion: Leeuwenhoek was not the true inventor of the microscope. That credit belongs to Zacharia Janssen (1580-1638), a fellow Dutchman who was a spectacle maker. Believing that two lenses would magnify better than one, he placed a convex lens at each end of a tube, thereby inventing the first microscope in 1590, half a century before Leeuwenhoek's time. Although Leeuwenhoek was not the first to use the instrument, he was the first to apply it to the understanding of biology. Through sheer force of patience and keen observation, this layman laid the foundation for future discoveries, especially those relating to infectious diseases. For this, he rightly deserves the title of father of microscopy. Regrettably, his entire collection of microscopes was auctioned off following his death in 1723 at the age of 90, and only nine have survived to the present day.

REFERENCES

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