ANTONI VAN LEEUWENHOEK
1632-1723

Leeuwenhoek was born into a lower middle class family in the town of Delft in Holland, the son of a basket-maker. He received only a primary education and did not learn Latin, the scientific language of the time. He owned a draper's shop and was later appointed to several official positions in the city of Delft: in 1669 he was admitted as land surveyor, and in 1679 he was appointed as wine gauger. He always lived in his native town and his visit to London in 1668 was the only occasion on which he went abroad. Van Leeuwenhoek married twice, and saw one child, Maria, to grow to adulthood. She survived him and protected his legacy.

Leeuwenhoek's fame rests solely on his microscopes and the studies he made with them. His hand-made microscopes were of the single-lens type and had a quality which was unsurpassed during his lifetime (maximum magnification: 270). He blew or ground the lenses himself, by a secret process. For each preparation he constructed a new microscope. Of the more than 500 microscopes he left at his death, only ten survive. Leeuwenhoek's manual skill allowed him to make preparations of the highest quality and his study of these led to many discoveries.

Leeuwenhoek was introduced to Cartesian natural philosophy by Christiaan Huygens and the Delft physicians R. de Graaf, and C. 's Gravesande. Whenever Leeuwenhoek tried to explain his observations or put them in a wider context, he used a Cartesian framework. De Graaf introduced Leeuwenhoek to the Royal Society in London, where his observations aroused great interest. Leeuwenhoek wrote up the results of his researches in more than 350 letters, of which the greater part was sent to the Royal Society in London, which elected him as Fellow in 1680. A substantial number of the letters was published in English translation in the Society's *Philosophical Transactions*, but there were also contemporary editions of a part of his work in Dutch and in a Latin translation.

Leeuwenhoek's most important discoveries were spermatozoa (of humans and all kinds of animals), red blood cells, and many kinds of what we now call micro-organisms. But his interests covered practically all aspects and forms of inanimate and animate nature. Thus, scattered in his letters are comparative descriptions of the cellular structure of different kinds of wood, the shape of crystals from salts

obtained by burning to ashes various kinds of plants, bacteria in dental plaque, striated muscle cells, and so on. The discovery that satisfied him most was the factual demonstration of the circulation of the blood in the tail fin of a living young eel in 1688.

The encyclopedic nature of his work might hide the fact that notwithstanding his lack of scientific training Leeuwenhoek was concerned with a few general problems: the (microscopical) structure of organisms and the operating mechanisms of reproduction and growth. His starting point was the concept of uniformity in Nature and his explanations were based upon the Cartesian concept of matter. Leeuwenhoek therefore constructed a theory that all matter consisted of 'globules'. His enduring opposition to the idea of spontaneous generation for example was based on the conviction that the Creator had created the world in a uniform and perfect manner and was supported by the discovery of many very small organisms that normally escaped the eye but nevertheless appeared to possess a perfection equal to that of higher animals and plants.

Leeuwenhoek supported the preformation theory of generation, especially the animalculist version. The spermatozoa themselves were in fact preformed organisms, while the female reproductive organs only served to nourish them to maturity. Contrary to some contemporary microscopists Leeuwenhoek never claimed to have seen a miniature organism in the head of a spermatozoon. In his studies of the growth and nourishment of plants he made elaborate studies of sap transport and compared it to the circulation of blood in animals.

After the decline and fall of scientific microscopy at the end of the seventeenth century, Leeuwenhoek was the only one who continued this type of study, pursuing it until his final days. Despite the admiration aroused by Leeuwenhoek's often spectacular observations, his influence on the development of scientific ideas and concepts was scant. This was due in part to Leeuwenhoek's secretiveness, so that his observations could only be repeated by others with great difficulty. The lack of adequate concepts for microscopical structures such as cells and their parts was another reason for the eclipse of his work in the eighteenth century.

Leeuwenhoek died in Delft in 1723, a celebrity who had attracted many scientists, politicians and royalty to the city.

Primary works

Poggendorff, vol. 1, 1404; Leeuwenhoek's personal papers have been lost, but many of his original letters are to be found in the archives of the Royal Society, London. The location of the manuscripts is given in the *Collected Letters*; A. van Leeuwenhoek, *Brieven*, 4 vols (Leiden: C. Boutesteyn/Delft: A. Beman, 1684-1718), and *idem*, *Opera Omnia* (Leiden: J.A. Langerak/Delft: A. Beman, 1685-1719; reprints Bruxelles: Culture et Civilisation, 1966 [only the *Arcana naturae detecta* of 1696 and the *Continuatio arcanorum* of 1697], and Hildesheim/New York: Olms, 1971) are the contemporary Dutch and Latin editions. These editions have a very complicated history which is elucidated in Schierbeek, *Leeuwenhoek*, vol. 2, 488-505 (see below); S. Hoole, *The Select Works of Antony van Leeuwenhoek Containing his Microscopical Discoveries in Many of the Works of Nature*, 2 vols (London: H. Fry/G. Sidney/The Philanthropic Society, 1798-1807; reprint New York: Arno Press, 1977); *Alle de Brieven van Antoni van Leeuwenhoek/The Collected Letters of Antoni van Leeuwenhoek*, 15 vols (Amsterdam/Lisse: Swets and Zeitlinger, 1939-1998), a historical-critical edition of all his letters with a modern English translation, to be completed with vol. 19 in 2002. Reviewed by M. Fournier, 'Zo Leeuwenhoek, zo Leeuwenhoek-Commissie', *TGGNWT* 13 (1990) 267-271, and by E.G. Ruestow, 'Of a man and his microscopes: Widening the perspective of early modern science', *Tractrix* 3 (1991) 173-182.

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[L.C.P.]