

## RESEARCH LETTER – Professional Development

**van Leeuwenhoek microscopes—where are they now?**

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E-mail: [l.a.robertson@tudelft.nl](mailto:l.a.robertson@tudelft.nl)**One sentence summary:** The story and fate of van Leeuwenhoek's microscopes and other lenses as revealed by primary and historical secondary documents are reviewed.

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**ABSTRACT**

When Antonie van Leeuwenhoek died, he left over 500 simple microscopes, aalkijkers (an adaption of his microscope to allow the examination of blood circulation in the tails of small eels) and lenses, yet now there are only 10 microscopes with a claim to being authentic, one possible aalkijker and six lenses. He made microscopes with more than one lens, and possibly three forms of the aalkijker. This paper attempts to establish exactly what he left and trace the fate of some of the others using the earliest possible documents and publications.

**Keywords:** single lens microscopes; aalkijker; auction catalogue; biohistory**INTRODUCTION**

Optical microscopes seem to have developed along parallel lines. Modern compound instruments are claimed to be derived from the two-lensed tube invented by the Jansens towards the end of the 16th century (Harting 1850). It is ironic that some of the most significant discoveries in microscopy were made using the simpler, single lens version which probably developed from the magnifying glasses of Roger Bacon in the 13th century (Clay and Court 1932). Antonie van Leeuwenhoek was not the only person making and using single-lensed microscopes, although his were the simplest (see, for example, the review by van Cittert 1934a and Robert Hooke (1665) described one in the introduction to *Micrographia*). Making the lenses stronger also made them smaller and there is little difference between magnifying glasses and van Leeuwenhoek microscopes other than magnifying power.

'Little animals' were reported by others after van Leeuwenhoek's first descriptions. Despite his speculation about the wisdom of washing glasses and crockery in canal water containing little animals, and his idea that they might be the source of the microorganisms found in the mouth (van Leeuwenhoek 1713), he does not seem to have connected his little animals with illness. However, during his lifetime others were consid-

ering the implications and suggesting that his 'little animals' might cause diseases. These suggestions were largely ignored. In 1677, 'an observing person in the county' commented on recent letters in the *Philosophical Transactions* to the Royal Society (Anon 1677). He suggested that the discoveries of Mr van Leeuwenhoek implied that the air is also full of little animals. Periods of infection might be associated with periods of calm, east winds or humidity. In Slare (1683), he, when working on a cattle plague in Switzerland, that had Mr van Leeuwenhoek been there, he would have discovered some strange 'insect' or other. In CH (1702), he described his experiments to repeat van Leeuwenhoek's work. His pepper water experiments produced 'capillary worms' which seem to correspond with van Leeuwenhoek's bacteria. He then investigated the water draining from a dung heap, commenting that the microbial community was richer than in his pepper water samples.

For broader reviews of early microscopes and methods see, for example, Mayall (1886a,b), Clay and Court (1932), Ruestow (1996) and Fournier (1991). Meyer (1937) reviewed van Leeuwenhoek's methods.

Many compound microscopes, including Robert Hooke's, have survived, unlike the simpler microscopes of van Leeuwenhoek, possibly because the former are more obviously valuable.

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This article will review what is known about the fate of van Leeuwenhoek's microscopes and lenses, using primary and very early secondary sources that have become more readily accessible with electronic access to catalogues and archives.

### The fate of the microscopes and other magnifiers

When he died, van Leeuwenhoek left about 500 microscopes and lenses. Apparently, he preferred to glue a good preparation onto a microscope pin and then make a new microscope. His method of preparing his biconvex lenses has long been debated (e.g. Cohen 1937; Kingma Boltjes 1941), but it seems likely that he used different techniques, depending on his need. If he copied Hooke's method of melting glass rods to produce glass spheres, those lenses have not survived (Hooke 1665). Only one of the surviving lenses appears to have been blown (Engelsman 1983), the others were ground and polished. In van Leeuwenhoek (1694), he wrote that his glass blowing skills were limited, having learned by watching a demonstration by a glass blower at a fair in Delft.

Most of van Leeuwenhoek's microscopes were the familiar tiny, single-lensed, brass or silver microscopes. However, the drawing published by von Uffenbach (1754) after his visit to van Leeuwenhoek shows a microscope with two lenses side by side. In one portrait, Verkolije showed him holding a microscope with three lenses in a row. Two and three-lensed microscopes also feature in the catalogue (e.g. Fig. 1C) for the auction of his microscopes (see below). This arrangement might be to allow the use of more than one magnification to study a sample. It is very difficult to transfer fragile samples between microscopes.

#### Aalkijkers

In 1689, van Leeuwenhoek reported that he had modified his microscope to allow the examination of the circulation of the blood in the tails of young eels, tadpoles and small fish. Various translated names have been used for this modification, including eel-spy glass, aquatic microscope, water microscope and fish glass. For simplicity, this paper will use the shortest name, his own term—'aalkijker'. Note that while 'Figure' refers to the numbered pictures in this paper, 'fig' refers to the notation of the engraver on the original version of Fig. 2A.

The aalkijker consisted of a metal frame (Fig. 2A, fig 9) that could hold a glass tube with a living specimen inserted head down in water (Fig. 2A, fig 13). The frame could either be used with one of his normal microscope plates (Fig. 2A, figs 8 and 10), or with a smaller lens holder (Fig. 2A, figs 11 and 12) which might be more convenient with weaker lenses. At the time of writing, no examples of the earlier version are known to have survived. The nearest is a copy attributed to Mayall (catalogue 45541) in the Oxford Museum of the History of Science. In van Leeuwenhoek (1708), he mentioned that he had redesigned his aalkijker to make observations easier, but he did not provide an illustration. Fortunately, von Uffenbach (1754) provided a drawing of the modified version (Fig. 2B), which can also be seen on the frontispiece of the auction catalogue (Fig. 1B).

Another aalkijker version attributed to van Leeuwenhoek can be seen at the [Museum Boerhaave in Leiden \(Fig. 2C\)](#). The tube holder is shorter and the lens holder is permanently attached with detachable lenses. This version is similar to one attributed to van Musschenbroek from around the same time (Museum Boerhaave catalogue number V07005).

The auction catalogue (Rees 1747) lists three types of aalkijker (Table 1). Some were made of silver or brass with a glass tube to observe the circulation of the blood (corresponding to Fig. 2A, fig 3). Two copper examples were square (Fig. 2B). Others with glass tubes were described as 'small', one of which contained

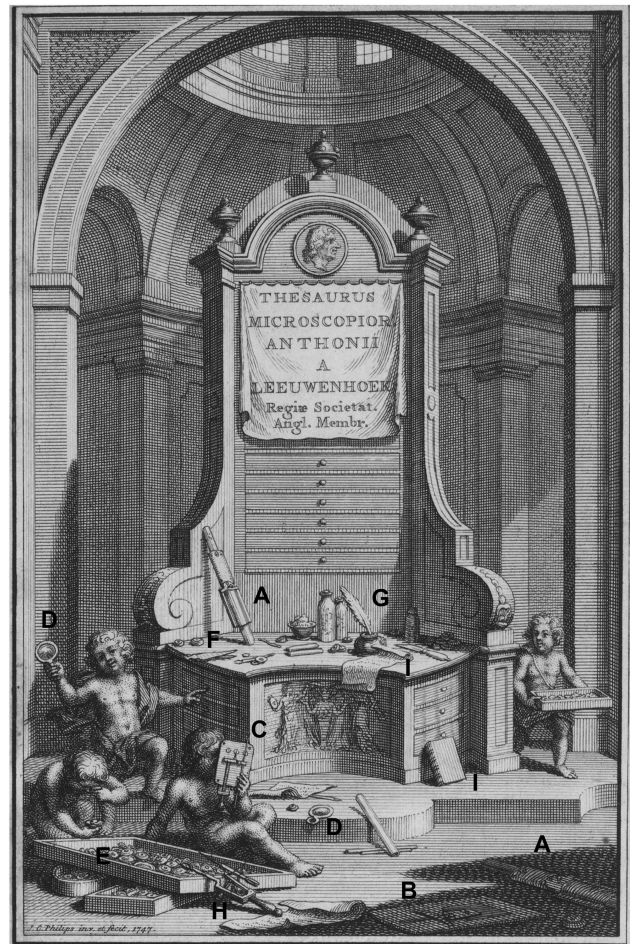


Figure 1. Frontispiece from the catalogue for the sale of the microscopes (Rees 1747). (A) original aalkijker; (B) newest form of aalkijker; (C) three-lensed microscope; (D) magnifying glass; (E) loose lenses; (F) tweezers; (G) quill pen and ink; (H) possibly microscope with weaker lens; (I) bound book.

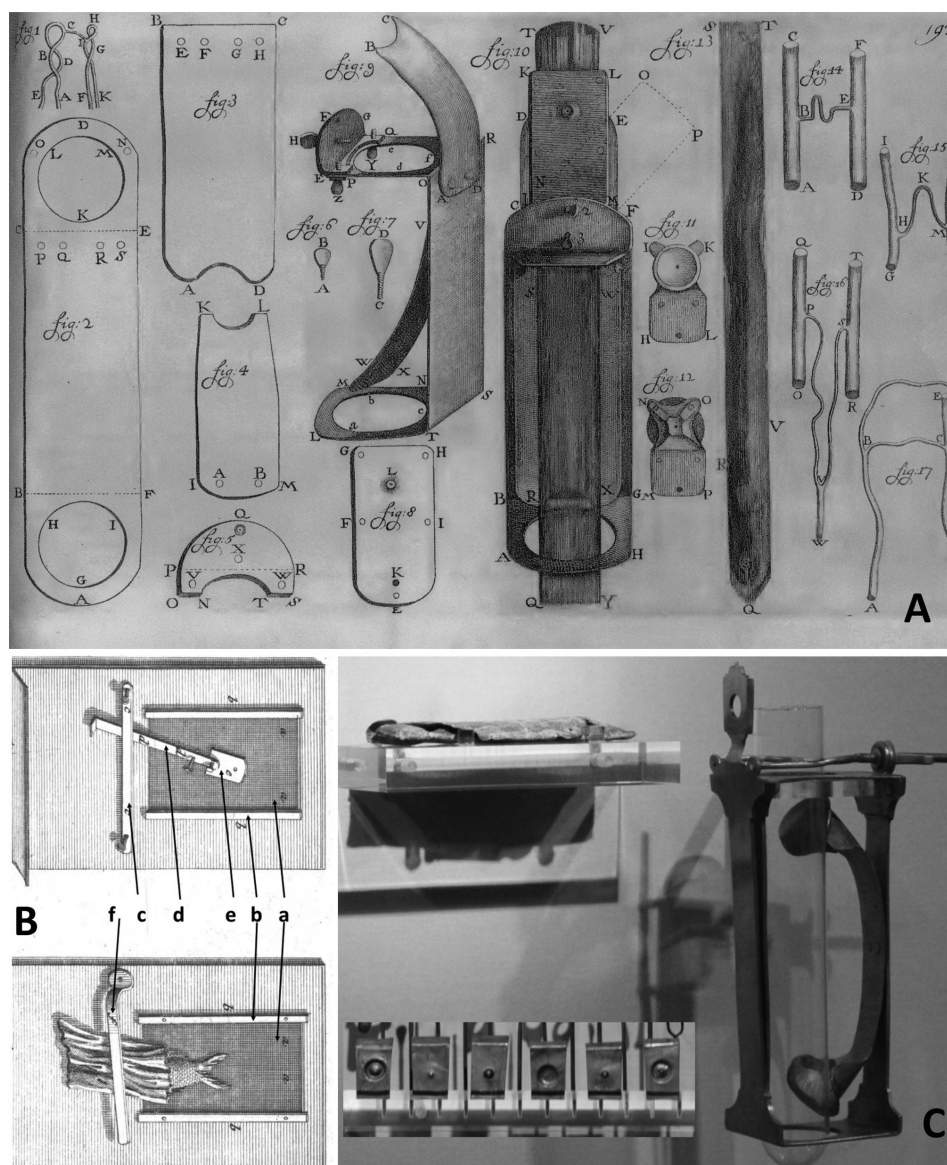
oyster embryos. van Seters (1933) suggested that this could refer to capillaries as von Uffenbach (1754) reported seeing oyster embryos in one.

#### The auction

Two years after Maria van Leeuwenhoek (1656–1745) died, her father's collection of microscopes was sold by auction at the St Lucas Gilde in Delft. **Two versions of the catalogue have survived (Rees 1747)**. One has the text in Dutch and Latin, the other shows the Dutch text and the name of the buyer with the price. The catalogue was described extensively by van Seters (1933), so it is only summarized here. There were 196 microscopy lots, many containing two microscopes per box, as van Leeuwenhoek had left them (Table 1). Some lots were sets of lenses. As well as the brass and silver microscopes, the catalogue also lists three made of gold and a few with lenses made of quartz or sand. The aalkijkers were sold singly. Nothing is said about the strengths of the various lenses, but samples are mentioned.

At first glance, the illustration at the front of the auction catalogue (Fig. 1) seems rather fanciful, but closer examination allows the identification of sale items. Two forms of the aalkijker are shown (A and B), as is a microscope with three lenses (C). The small magnifying glasses (D) are mentioned separately (as fire glasses) in the inventory of the van Leeuwenhoek house (Geesteranis 1745). The auction catalogue includes a number of





**Figure 2.** The aalkijker. Where an item is referred to as 'fig' rather than 'Figure', it refers to the original notation by the engraver on the picture. (A) The original aalkijker (van Leeuwenhoek 1689), showing it with the microscope plate fitted (fig 10), additional lenses (fig 11, fig 12) and its constituent parts. (B) Drawings of the updated aalkijker (von Uffenbach 1754). (a) glass plate; (b) brass plate; (c and f) retaining brass strips; (d) microscope mount; (e) microscope plate. (C) The aalkijker held by Museum Boerhaave in Leiden (catalogue number V07015) and a red lens case (catalogue number V07016) top left. Inset, lenses for the aalkijker (also V07016).

lenses, presumably indicated by the round items in the trays (E). Other items were in common use [e.g. quill pen and ink (G), book (I)], and similar tweezers (F) have survived and are in Leiden's Museum Boerhaave. The item (H) just to the right of the engravers signature is interesting. It appears to be the sample pin and adjusting screws from a microscope, but with a larger lens. This would provide a useful transition between magnifying glasses and the stronger lenses of the microscopes while allowing control of the sample's position and focus. The lacquered cabinets for storing the microscopes in the front hall of the van Leeuwenhoek house were also sold (Rees 1747).

Most of the buyers were Delft residents, and quite a few were notaries. Some people bought large numbers of microscopes, most notably Willem Vlaedingerwout (notary), who bought 20 lots and two of the cabinets, and Hendrick Halder (notary; 18 lots and two cabinets). The auctioneer, Adriaan Rees, bought the only gold microscope that sold (two others were withdrawn).

Others who bought multiple lots included Hendrik Verbrugge (coppersmith), Matthys van den Briel (seafarer), Willem Ouwens (doctor), Cornelis de Vegter (surgeon) and Baroness van Reede, among others. Dobell (1932) was surprised that the buyers were so local, but the sale happened long after van Leeuwenhoek's death, most of his friends were dead, and microscopy had moved on.

With the exception of the 10 microscopes discussed below (Fig. 3, Table 2), all of van Leeuwenhoek's original microscopes have disappeared. Two others are only known from photographs (Penso and Rampa 1981; van Zuylen 1981), but seem to have survived into the 20th century.

#### The Royal Society of London

van Leeuwenhoek selected 26 of his microscopes to be given to the Royal Society after his death. They were described in detail by Folkes (1722) and Baker (1739). All were made of silver

**Table 1.** Summary of the microscopes auctioned after the death of Maria van Leeuwenhoek (Rees 1747). Where used, 'fig(s)' refers to the engraver's notation on the original of Figure 2(A) and not the number of a Figure.

Metal	Lens material	Number of lenses	Number of microscopes
<b>Microscopes</b>			
Brass	Glass	1	96
Brass	Glass	1	88 <sup>1</sup>
Silver	Rock crystal	1	4
Silver	Sand	1	2
Silver	Glass	1	120
Silver	Glass	2	3
Silver	Glass	3	2
Brass & silver	Glass	1	1
Brass & silver	Glass	2	3
Gold	Glass	1	3
Total microscopes			322
<b>Aalkijkers</b>			
Square <sup>2</sup> , brass			2
Brass, <sup>3</sup> glass tube			6
Small <sup>3</sup> , brass, glass tube			11
Silver, glass tube			3
Brass & silver, glass tube			1
Total aalkijkers			23
Lenses in brass holders <sup>4</sup>	Glass		172

<sup>1</sup>The description uses the diminutive of the word used for the other microscopes and with an attached dish. It could refer to the basic microscope structure, but with the dish-like lens holders shown in the engraver's notation as figs 11 and 12 in Figure 2A in place of microscope plates. It might be the magnifier shown at H in Figure 1.

<sup>2</sup>See Figure 2B.

<sup>3</sup>See Figure 2A.

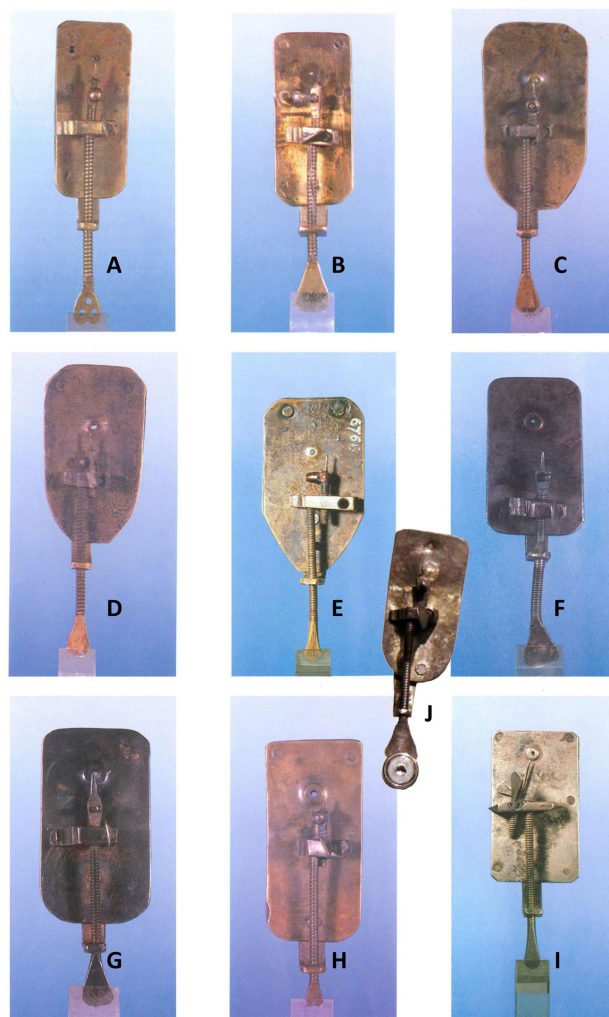
<sup>4</sup> See insert in Figure 2C. Alternatively, they could be un-mounted microscope plates (fig 8 in Figure 2A).

reportedly extracted from the ore by van Leeuwenhoek himself (Schierbeek 1947), with a range of magnifications (Table 3). They were arranged two to a box in drawers in a small cabinet, and originally had mounted samples. In a later publication, Baker (1754) rather indignantly wrote that several writers were claiming that Mr van Leeuwenhoek used globules or spheres of glass, but they obviously hadn't seen the microscopes. As he wrote his article, the microscopes given to the Royal Society were standing on his table and every one of them had a biconvex lens, not a sphere. It might be speculated that this was why van Leeuwenhoek was more successful with the single-lens microscope than others who used spheres.

Sadly, these microscopes disappeared in the first half of the 19th century. In 1855, Sir James South wrote to the Royal Society asking for an investigation into their loss (quoted in Ford 1983), but this came to nothing. The last person known to have borrowed them was Sir Everard Home (Clay and Court 1932), and there is no record of their having been seen again. It has been suggested that the van Leeuwenhoek microscopes might have been destroyed in the fire at Sir Everard's home that destroyed many of the papers of his late brother-in-law, Sir John Hunter (Cliff 1834; Anon 1904; Livesley and Pentelow 1978).

#### Gifts

Antonie van Leeuwenhoek never sold his microscopes. Indeed, despite the very high ranks of some of his visitors (Backer et al. 2014), there are only two cases where it is suggested that he gave microscopes away.



**Figure 3.** Microscopes with a claim to be surviving authentic van Leeuwenhoek microscopes (see Table 2). [Images (A–I) with permission from Museum Boerhaave, Leiden].

Folkes (1722) described a visit to Delft by Queen Mary, wife of William of Orange when, impressed by her interest, van Leeuwenhoek gave her two of his microscopes. Folkes said that an acquaintance had had Queen Mary's microscopes 'in his hands for some time', providing evidence that the gift had been made. However, these microscopes cannot be found. The scientific instruments held by the Royal Collection in Britain were transferred to the British Museum and thence to London's Science Museum, but the microscopes are not there. According to Clay and Court (1932), in the late 19th century, Sir Frank Crisp was building an extensive collection of microscopes with the intention of presenting them to the British Nation. He was therefore allowed to remove the microscopes from the 'George III collection' in Kings College, where they had been placed by Queen Victoria. Sadly, he didn't mention this planned gift in his will. After his death 'the Crisp collection', including the microscopes from the George III collection, was sold by auctions in 1923–1925 (Anon 1925; Gunther 1925). This collection included a van Leeuwenhoek microscope, which seems likely to have come from the Queen Mary gift. It hasn't been seen since. The auction house and its records were destroyed by bombing during World War II.

**Table 2.** The surviving microscopes and lenses for the aalkijker (an apparatus for examining the circulation of the blood in the tails of living eels, tadpoles and fish).

Microscope	Metal	Focal length (mm)	Magnification	Location
A <sup>1</sup>	Brass	2.12	118	Bought by Dirk Haaxman at the original auction, now <b>Museum Boerhaave, Leiden.</b>
B <sup>1</sup>	Brass	3.39	74	Bought by Dirk Haaxman at the original auction, now <b>private collection.</b>
C <sup>1</sup>	Brass	0.94	266	<b>University Museum, Utrecht</b>
D <sup>1</sup>	Brass	2.28	110	<b>Natural History Museum, Antwerp</b>
E <sup>1</sup>	Brass	2.24	112	<b>Deutsches Museum, Munich</b>
F <sup>1</sup>	Silver	3.31	80	<b>Museum Boerhaave, Leiden</b>
G <sup>1</sup>	Silver	3.61	69	Previously <b>private collection</b> , unknown since an auction at Christie's in 2009
H <sup>1</sup>	Brass	no lens		Bought by Dirk Haaxman at the original auction, previously at Delft University of Technology, since 1983 in <b>Museum Boerhaave, Leiden</b>
I <sup>1</sup>	Brass	1.5	167	<b>Deutsches Museum, Munich</b>
J <sup>1</sup>	Silver	3.66	68	Private ownership until 1983 when donated to <b>Museum Boerhaave, Leiden (Fournier 2002)</b>
Lens 1 <sup>2</sup>	Brass	8	32	<b>Museum Boerhaave, Leiden</b>
Lens 2 <sup>2</sup>	Brass	5	50	<b>Museum Boerhaave, Leiden</b>
Lens 3 <sup>2</sup>	Brass	5	50	<b>Museum Boerhaave, Leiden</b>
Lens 4 <sup>2</sup>	Brass	3.8	65	<b>Museum Boerhaave, Leiden</b>
Lens 5 <sup>2</sup>	Brass	1.9	150	<b>Museum Boerhaave, Leiden</b>

<sup>1</sup>see Figure 3.<sup>2</sup>see Figure 2C.**Table 3.** Baker's measurements of the Royal Society microscopes (Baker 1739), recalculated to metric units and an eye distance of 250 mm, for comparison with Table 2.

Number of microscopes	Metal	Focal length (f) (mm)	Magnification
1	Silver	1.27	200
1	Silver	1.52	166
1	Silver	1.78	143
3	Silver	2.03	125
3	Silver	2.28	111
8	Silver	2.54	100
2	Silver	2.79	90
3	Silver	3.05	83
2	Silver	3.55	71
1	Silver	3.81	66
1	Silver	5.08	50

In 1697, Peter the Great invited van Leeuwenhoek to visit the boat on which he was travelling to explain his discoveries. It is frequently claimed that van Leeuwenhoek gave the Czar microscopes and one of his aalkijkers. However, there is no mention of this gift in the account of the meeting written by a friend of van Leeuwenhoek's, even though his parting with one or more microscopes would have been a remarkable event (van Loon 1731). The claim seems to be based on Haaxman's story (Haaxman 1875; Crommelin 1926) that a Professor de Gorter (probably David

de Gorter, Royal Physician to Elizabeth, Empress of Russia) had brought a microscope, lenses in a red morocco case with 'Anth. Van Leeuwenhoek' on the lid, and an aalkijker from Russia. However, there is no evidence to link the two events which happened almost 200 years apart. It might (as speculated by Dobell 1932) have happened, but de Gorter's microscopes might equally easily have come from the auction, although the catalogue does not mention a red morocco case.

#### The surviving microscopes

Nine van Leeuwenhoek microscopes with claims to be authentic were assembled for the 'Beads of Glass' exhibition (Bracegirdle 1983). These microscopes, together with a tenth acquired by the Boerhaave Museum in Leiden during the exhibition (Fournier 2002), are the 10 known survivors shown in Fig. 3 and Table 2. Three of them (A, B and H in Fig. 3) previously belonged to the Haaxman family (relatives of van Leeuwenhoek), having been bought by Dirk Haaxman at the auction (Rees 1747; Rooseboom 1939) and retained by the family until the 20th century. None of the other microscopes can be traced back to specific auction lots, and the provenance of several can only be tracked to the 19th century.

Microscope H (Fig. 3) was, for a time, exhibited in the entrance hall of Delft University of Technology's Microbiology Laboratory, but it has been in the greater security of Leiden's Museum Boerhaave since 1983 (Bracegirdle 1983), and a copy has taken its place in Delft.

Like the Royal Society microscopes, all surviving microscopes have biconvex lenses (van Cittert 1932, 1933, 1934b; Engelsman



1983; van Seters 1933) and have all lost their samples. Only a few of van Leeuwenhoek's samples have survived (Dobell 1932; Cole 1937a,b; Ford 1981).

#### Microscope copies

Copying a van Leeuwenhoek microscope is relatively simple. Since they are simply hand made from metal and glass, it is difficult to be certain of the provenance of a microscope unless it has supporting documentation or auction or assay marks. On the rare occasions when they appear, newly discovered microscopes are generally compared to known examples. If they do not match a known microscope, they are possibly authentic. Microscopes A and C in Fig. 3 seem to have been the most frequently copied. Where the maker and date are known, copies such as those made of the Utrecht microscope by John Mayall (Crisp 1886; van Zuylen 1981) have acquired museum status (e.g. items 45541 and Wh.1817 in the catalogues of Cambridge's Museum of the History of Science and the Whipple Museum, respectively). Modern copies are often, but not always, marked (e.g. catalogue number 1929–802 at London's Science Museum, and 41858 in Cambridge). Instructions for making copies are available on the internet, and some people are making them for sale. However, some of these copies have a glass sphere as a lens, limiting their use. At the time of writing, Museum Boerhaave in Leiden is selling copies of one of their microscopes with lenses intended for mobile phones, thereby making them useable.

Copies of the microscopes with good quality lenses can be found (e.g. Loncke 2006a,b), and it is possible to repeat some of van Leeuwenhoek's experiments (Robertson 2015). Combined with a modern digital camera, it is even possible to make photographs and film clips (Robertson 2014).

## CONCLUSION

At first glance, it might seem unreasonable that around 500 microscopes and lenses have vanished. Some microscopes were probably discarded by heirs who didn't know what they were, or thought that they were outdated. The gold and silver ones were probably melted down. Others were obviously re-sold, and a few have appeared in later inventories of other estates, only to vanish again. Abram Edens, the man who delivered van Leeuwenhoek's bequest to the Royal Society (Rusnock 1996), bought 10 brass and two silver microscopes at the auction, as well as one of the modified aalkijkers and a set of lenses, but the inventory of his own estate only lists three microscopes and eight lenses (Anon 1765). In 1753, Jan Arnold van Orsoy left one brass and four silver microscopes which were sold to men recorded only as Jongerhelt and Tilenburg (Anon 1754). In 1758, Aron de Pinto left one (Anon 1785). As late as 1823, Pieter van Buren left one among his collection of curiosities (Anon 1823).

The microscopes are tiny, the mounted lenses even smaller, and who could have predicted that such unprepossessing things were important and would eventually become so valuable and should be treated with care? In 2009, a silver van Leeuwenhoek microscope (Fig. 3G) sold at auction for €350 000, and it is tempting to think that the publicity surrounding the sale would have encouraged owners of previously unrecognized microscopes to come forward. Microscope J in Fig. 3 came to light after its owner visited the 'Beads of Glass' exhibition in Leiden and learned what it was (Fournier 2002)—could there still be more out there?

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**Conflict of interest.** None declared.

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